

**SPECIFICATION
ISSUED FOR TENDER**

**INGONISH CIVIL BUILDING
Ingonish, Nova Scotia**



July 18, 2014

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Part 1 General

1.1 SECTION INCLUDES

- .1 Documents and terminology.
- .2 Associated requirements.
- .3 Work expectations.
- .4 Work by other parties.
- .5 Premises usage.

1.2 RELATED SECTIONS

- .1 Section 01 78 10 - Closeout Submittals.
- .2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 RELATED DOCUMENTS

- .1 Section 00 52 45 - Agreement and Definitions.
- .2 Section 00 72 13 - General Conditions.
- .3 Section 00 73 12 - Supplementary Conditions.
- .4 All other Division 01 specification sections.
- .5 Division 01 sections describe requirements applicable to all Sections within Divisions 02 to 49 inclusive.

1.4 WORDS AND TERMS

- .1 Refer to and acknowledge other words, terms, and definitions in the contract Definitions. Additional words and terms are cited in Section 00 52 43 described in Supplementary Conditions.

1.5 COMPLEMENTARY DOCUMENTS

- .1 Refer to Section 00 52 13 for words and terms.
- .2 Drawings, specifications, and schedules are complementary each to the other and what is called for by one to be binding as if called for by all. Should any discrepancy appear between documents which leave doubt as to the intent or meaning, abide by Precedence of Documents article below or obtain direction from the Department Representative.
- .3 Drawings indicate general location and route of conduit and wire/conductors. Install conduit or wiring/conductors and plumbing piping not shown or indicated diagrammatically in schematic or riser diagrams to provide an operational assembly or system.
- .4 Install components to physically conserve headroom, to minimize furring spaces, or obstructions.
- .5 Locate devices with primary regard for convenience of operation and usage.

- .6 Examine all discipline drawings, specifications, and schedules and related Work to ensure that Work can be satisfactorily executed. Conflicts or additional work beyond work described to be brought to attention of Department Representative.

1.6 DESCRIPTION OF THE WORK

- .1 Work of this Contract comprises general construction of a municipal building at Ingonish, Nova Scotia. The work comprises building and site work.
- .2 The Contractor is to apply and pay for all permits for the project.
- .3 Division of the Work among suppliers or vendors is solely the Contractor's responsibility. The Department Representative assumes any responsibility to act as an arbiter to establish subcontract terms between sectors or disciplines of work.

1.7 WORK SEQUENCE

- .1 Construct Work to accommodate Department Representative's usage requirements during the construction period, coordinate construction schedule and operations with Department Representative.
- .2 Coordinate Progress Schedule and with Department Representative use during construction.
- .3 Maintain fire access and control of fire protection equipment.

1.8 DOCUMENTS PROVIDED

- .1 Department Representative will supply the Contractor with ten (10) sets of Contract Documents for construction purposes, which includes two (2) sets for record "as-built" purposes.
- .2 The Contractor may obtain additional sets of Contract Documents at the cost of printing, handling and shipping.
- .3 An electronic set of documents will be provided near the end of the Project for purposes of transferring changed information recorded on as-built documents to the electronic Record Documents.

1.9 WORK BY DEPARTMENT REPRESENTATIVE

- .1 Items noted NIC (Not in Contract), are minor equipment that will be supplied and installed by Department Representative.

1.10 CONTRACTOR USE OF PREMISES

- .1 Contractor has unrestricted use of the site of the new addition until Substantial Performance of the Work. Once the locks have been changed and alarms become activated all security requirements as set out in the specifications need to be adhered to.
- .2 Construction Operations: Limited to areas noted on Drawings.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Pre-installation and Scheduled progress meetings.

1.2 RELATED SECTIONS

- .1 Section 01 32 00 - Construction Progress Documentation.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 COORDINATION

- .1 Perform coordination of progress schedules, submittals, use of site, temporary utilities, construction facilities and construction Work, with progress of Work of others, under instructions of Department Representative.
- .2 A full-time, on-site, Superintendent is a requirement for this project.

1.4 CONSTRUCTION ORGANIZATION AND START-UP

- .1 Within fifteen (15) days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Senior representatives of the Contractor, major Subcontractors, field inspectors and supervisors are to be in attendance.
- .3 Establish time and location of meeting and notify parties concerned minimum five (5) days before meeting.
- .4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- .5 Agenda to include following:
 - .1 Appointment of official representative of participants in Work.
 - .2 Schedule of Work, progress scheduling as specified in Section 01 32 00.
 - .3 Schedule of submission of shop drawings, samples, colour chips as specified in Section 01 33 00.
 - .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences as specified in Section 01 51 00.
 - .5 Site safety as specified in Section 01 35 29.
 - .6 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, and administrative requirements.
 - .7 Department Representative-furnished Products.
 - .8 Record drawings as specified in Section 01 78 40.
 - .9 Maintenance material and data as specified in Section 01 78 40.

- .10 Take-over procedures, acceptance, and warranties as specified Section 01 78 40.
- .11 Monthly progress claims, administrative procedures, photographs, and holdbacks.
- .12 Appointment of inspection and testing agencies or firms as specified in Section 01 43 00.
- .13 Insurances and transcript of policies.

1.5 ON-SITE DOCUMENTS

- .1 Maintain at job site, one copy each of the following:
 - .1 Contract drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed shop drawings.
 - .5 Change orders.
 - .6 Other modifications to Contract.
 - .7 Field test reports.
 - .8 Copy of approved Work schedule.
 - .9 Manufacturers' installation and application instructions.
 - .10 Labour conditions and wage schedules.
 - .11 Applicable current editions of municipal regulations and by-laws. Current building codes, complete with addenda bulletins applicable to the Place of the Work.

1.6 SCHEDULES

- .1 Submit preliminary construction progress schedule as specified in Section 01 32 00 to Department Representative coordinated with Department Representative's project schedule.
- .2 After review, revise and resubmit schedule to comply with revised project schedule.
- .3 During progress of Work revise and resubmit monthly as directed by Department Representative.

1.7 CONSTRUCTION PROGRESS MEETINGS

- .1 During the course of the project, schedule progress meetings every two weeks unless otherwise scheduled by Department Representative.
- .2 Contractor, major subcontractors involved in Work and Department Representative are to be in attendance.
- .3 Notify parties minimum five (5) business days prior to meetings.
- .4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within five (5) business days after meeting.
- .5 Agenda to include following:

- .1 Review, approval of minutes of previous meeting.
- .2 Review of Work progress since previous meeting.
- .3 Field observations, problems, conflicts.
- .4 Problems which impede construction schedule.
- .5 Review of off-site fabrication delivery schedules.
- .6 Corrective measures and procedures to regain projected schedule.
- .7 Revision to construction schedule.
- .8 Progress schedule, during succeeding work period.
- .9 Review submittal schedules: expedite as required.
- .10 Maintenance of quality standards.
- .11 Review proposed changes for affect on construction schedule and on completion date.
- .12 Review site safety and security issues.
- .13 Other business.

1.8 SUBMITTALS

- .1 Prepare and issue submittals to Department Representative for review.
- .2 Submit preliminary Shop Drawings, product data and samples as specified in Section 01 33 00 for review for compliance with Contract Documents; for field dimensions and clearances, for relation to available space, and for relation to Work of other contracts. After review, revise and resubmit for transmittal to Department Representative.
- .3 Submit requests for payment for review, and for transmittal to Department Representative.
- .4 Submit requests for interpretation of Contract Documents, and obtain instructions through Department Representative.
- .5 Process substitutions through Department Representative.
- .6 Process change orders through Department Representative.
- .7 Deliver closeout submittals for review and preliminary inspections, for transmittal to Department Representative.

1.9 CLOSEOUT PROCEDURES

- .1 Notify Department Representative when Work is considered ready for Substantial Performance.
- .2 Accompany Department Representative on preliminary inspection to determine items listed for completion or correction.
- .3 Comply with Department Representative's instructions for correction of items of Work listed in executed certificate of Substantial Performance and for access to Department Representative-occupied areas.
- .4 Notify Department Representative of instructions for completion of items of Work determined in Department Representative's final inspection.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Schedules, form, content, submission.
- .2 Critical path scheduling.
- .3 Progress photographs.
- .4 Submittals schedule.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 SCHEDULES

- .1 Submit schedules as follows:
 - .1 Submittal Schedule for Shop Drawings and Product Data.
 - .2 Submittal Schedule for Samples.
 - .3 Product Delivery Schedule.
 - .4 Shutdown or closure activity.
- .2 Schedule Format.
 - .1 Prepare schedule in form of a horizontal Gantt bar chart.
 - .2 Provide a separate bar for each major item of work.
 - .3 Split horizontally for projected and actual performance.
 - .4 Provide horizontal time scale identifying first Working Day of each week.
 - .5 Format for listings: Table of Contents of the Project Manual.
 - .6 Identification of listings: By specification Section numbers.
- .3 Schedule Submission.
 - .1 Submit initial format of schedules within fifteen (15) business days after award of Contract.
 - .2 Submit schedules in electronic format, forward through e-mail as *.pdf files.
 - .3 Department Representative will review schedule and return review copy within ten (10) days after receipt.
 - .4 Resubmit finalized schedule within seven (7) days after return of review copy.
 - .5 Submit revised progress schedule with each application for payment.
 - .6 Distribute copies of revised schedule to:
 - .1 Job site office.

- .2 Subcontractors.
- .3 Other concerned parties.
- .7 Instruct recipients to report to Contractor within ten (10) days, any problems anticipated by timetable shown in schedule.

1.4 CONSTRUCTION PROGRESS SCHEDULING

- .1 Submit initial schedule in duplicate within fifteen (15) days after date of Department Representative-Contractor Agreement.
- .2 Revise and resubmit as required.
- .3 Submit revised schedules with each Application for Payment, identifying changes since previous version.
- .4 Submit a horizontal bar chart with separate line for each major portion of Work or operation, identifying first work day of each week.
- .5 Show complete sequence of construction by activity, identifying Work of separate stages and other logically grouped activities. Indicate the early and late start, early and late finish, float dates, and duration.
- .6 Indicate estimated percentage of completion for each item of Work at each submission.
- .7 Indicate submittal dates required for shop drawings, product data, samples, and product delivery dates, including those furnished by Department Representative and required by Allowances.
- .8 Include dates for commencement and completion of each major element of construction as follows.
 - .1 Site clearing.
 - .2 Site utilities.
 - .3 Foundation Work.
 - .4 Structural framing.
 - .5 Special Subcontractor Work.
 - .6 Equipment Installations.
 - .7 Finishes.
- .9 Indicate projected percentage of completion of each item as of first day of month.
- .10 Indicate progress of each activity to date of submission schedule.
- .11 Indicate changes occurring since previous submission of schedule:
 - .1 Major changes in scope.
 - .2 Activities modified since previous submission.
 - .3 Revised projections of progress and completion.
 - .4 Other identifiable changes.
- .12 Provide a narrative report to define:
 - .1 Problem areas, anticipated delays, and impact on schedule.

- .2 Corrective action recommended and its effect.
- .3 Effect of changes on schedules of other prime contractors.

1.5 CRITICAL PATH SCHEDULING

- .1 Include complete sequence of construction activities.
- .2 Show projected percentage of completion of each item as of first day of month.
- .3 Indicate progress of each activity to date of submission schedule.
- .4 Show changes occurring since previous submission of schedule:
 - .1 Major changes in scope.
 - .2 Activities modified since previous submission.
 - .3 Revised projections of progress and completion.
 - .4 Other identifiable changes.

1.6 PROGRESS PHOTOGRAPHS

- .1 Digital Photography:
 - .1 Submit electronic copy of colour digital photography in *.jpg format, minimum 4 megapixel resolution.
 - .2 Identification: Name and number of project and date of exposure indicated.
- .2 Frequency: Monthly with progress statement.

1.7 SUBMITTALS SCHEDULE

- .1 Include schedule for submitting shop drawings, product data, samples and construction information.
- .2 Indicate dates for submitting, review time, resubmission time, and last date for meeting fabrication schedule.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Shop drawings and product data.
- .2 Samples.
- .3 Certificates and transcripts.

1.2 RELATED SECTIONS

- .1 Section 01 32 00 - Construction Progress Documentation.
- .2 Section 01 78 10 - Closeout Submittals.
- .3 Other sections requesting submittals.
- .4 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 ADMINISTRATIVE

- .1 Submit to Department Representative submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Work affected by submittal shall not proceed until review is complete.
- .3 Present Shop Drawings, product data, samples and mock-ups in Imperial inch-pound units.
- .4 Review submittals prior to submission to Department Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents.
- .5 Submittals not stamped, signed, dated, identified as to specific project, and attesting to their being reviewed will be returned without being examined and shall be considered rejected.
- .6 Notify Department Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are coordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Department Representative's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Department Representative review.
- .10 Keep one (1) reviewed copy of each submission on site.

1.4 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "Shop Drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .3 Allow ten (10) days for Department Representative's review of each submission.
- .4 Adjustments made on Shop Drawings by Department Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Department Representative prior to proceeding with Work.
- .5 Make changes in Shop Drawings as Department Representative may require, consistent with Contract Documents. When resubmitting, notify Department Representative in writing of any revisions other than those requested.
- .6 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .7 Submissions shall include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.

- .7 Operating weight.
- .8 Wiring diagrams.
- .9 Single line and schematic diagrams.
- .10 Relationship to other parts of the Work.
- .8 After Department Representative's review, distribute copies.
- .9 Submit electronic copy of Shop Drawings for each requirement requested in specification Sections and as Department Representative may reasonably request. Hardcopy of Shop Drawings submittals will not be accepted.
- .10 Submit electronic copy of product data sheets or brochures for requirements requested in specification sections and as requested by Department Representative where Shop Drawings will not be prepared due to standardized manufacture of product. Hardcopy submittals of Product Data will not be accepted.
- .11 Delete information not applicable to project.
- .12 Supplement standard information to provide details applicable to project.
- .13 If upon review by Department Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If Shop Drawings are rejected, noted copy will be returned and re-submission of corrected Shop Drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

1.5 SAMPLES

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Department Representative's business address.
- .3 Notify Department Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Department Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Department Representative prior to proceeding with Work.
- .6 Make changes in samples which Department Representative may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.6 MOCK-UP

- .1 Erect mock-ups to Section 01 45 00.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Safety requirements and adherence.

1.2 RELATED SECTIONS

- .1 Section 01 31 00 - Project Managing and Coordination.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 REFERENCES

- .1 Province of Nova Scotia: Occupational Health and Safety Act, Regulation and Code R.S.A -Amended 1995, including requirements for a "Prime Contractor" as defined by the Act.

1.4 SAFETY PLAN

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to commencing any site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Department Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.5 RESPONSIBILITY

- .1 The "Prime Contractor" according applicable local jurisdiction, is responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.
- .3 Should any unforeseen or peculiar safety-related factor, hazard, or condition become evident during performance of Work, and follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction. Advise Department Representative verbally and in writing.

1.6 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00.

- .2 Submit site-specific Health and Safety Plan: Within seven (7) days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
- .3 Submit necessary copies of Contractor's authorized representative's work site health and safety inspection reports to authority having jurisdiction, weekly.
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
- .5 Submit copies of incident and accident reports.
- .6 Submit Material Safety Data Sheets (MSDS) to Department Representative.
- .7 Department Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .8 Medical Surveillance: Where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Department Representative.
- .9 On-site Contingency and Emergency Response Plan: Address standard operating procedures to be implemented during emergency situations.
- .10 File Notice of Project with Provincial authorities prior to commencement of Work.

1.7 SAFETY ACTIVITIES

- .1 Perform site specific safety hazard assessment related to project.
- .2 Schedule and administer Health and Safety meeting with Department Representative prior to commencement of Work.

1.8 HEALTH AND SAFETY COORDINATOR

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Coordinator. Health and Safety Coordinator must:
 - .1 Have minimum two (2) years' site-related working experience specific to activities associated with health and safety.
 - .2 Have working knowledge of occupational safety and health regulations.
 - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
 - .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
 - .5 Be on site during execution of Work and report directly to and be under direction of site supervisor.

1.9 POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with Department Representative.

1.10 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Department Representative.
- .2 Provide Department Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Department Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.11 HAZARDOUS WORK

- .1 Blasting or other use of explosives is not permitted without prior receipt of written instruction by Department Representative.
- .2 Use powder actuated devices only after receipt of written permission from Department Representative.

1.12 WORK STOPPAGE

- .1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

1.13 FIRE PROTECTION

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by insurance companies having jurisdiction governing codes, regulations and bylaws.
- .2 Burning rubbish and construction waste materials is not permitted on site.
- .3 Maintain placed or installed fire resistive construction to protect the portions of the Work during construction.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Site fires.
- .2 Site drainage.
- .3 Site clearing and plant protection.
- .4 Work adjacent to waterways.
- .5 Pollution control.

1.2 RELATED SECTIONS

- .1 Section 01 74 00 - Cleaning and Waste Processing.
- .2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 FIRES

- .1 Fires and burning of rubbish on site not permitted.

1.4 DRAINAGE

- .1 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.
- .2 Do not pump water containing suspended materials into waterways, sewer or drainage systems.
- .3 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements and Section 01 57 13.

1.5 SITE CLEARING AND PLANT PROTECTION

- .1 Protect trees and plants on site and adjacent properties where indicated.
- .2 Wrap in burlap, trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2 metres.
- .3 Protect roots of designated trees to drip-line during excavation and site grading to prevent disturbance or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .4 Minimize stripping of topsoil and vegetation.
- .5 Restrict tree removal to areas indicated, or as designated by Department Representative.

1.6 WORK ADJACENT TO WATERWAYS

- .1 Do not operate construction equipment in waterways.

- .2 Do not use waterway beds for borrow material without Department Representative's approval.
- .3 Do not dump excavated fill, waste material or debris in waterways.
- .4 Design and construct temporary crossings to minimize erosion to waterways.
- .5 Do not skid logs or construction materials across waterways.
- .6 Avoid indicated spawning beds when constructing temporary crossings of waterways.
- .7 Do not blast under water or within 100 metres of indicated spawning beds.

1.7 POLLUTION CONTROL

- .1 Maintain temporary erosion and pollution control features installed under this contract.
- .2 Control emissions from equipment and plant to local authorities emission requirements.
- .3 Prevent sandblasting and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Project security requirements.

1.2 OVERVIEW

- .1 Due to the nature of the work and client operations on the site, security regulations pertaining to the site and existing operations will apply to all work carried out AFTER Substantial Performance of the contract is achieved and the building is occupied by Departmental Representatives. These regulations include:
 - .1 Control and limit of movement of construction workers at the site.
 - .2 Escort and continuous supervision of workers by security personnel.
 - .3 Workers must undergo a security clearance process.
 - .4 Specific rules and regulations as specified in this section and as directed by the Departmental Representative to be stringently followed.
- .2 It is the Contractor's responsibility to:
 - .1 Submit necessary documentation required and obtain security clearances for all workers;
 - .1 Contractor must submit security applications for all required individuals within two (2) weeks following contract award.
 - .2 Become familiar with and abide by security rules and regulations;
 - .3 Brief all workers and subcontractors in respect of the security regulations and ensure that they abide by all rules and directives.
- .3 The Departmental Representative will coordinate a pre-construction meeting between Contractor and Security Personnel who will provide details and directives on control and movement on site.
- .4 Any infraction of site security regulations on the part of the Contractor, members of work force or any Subcontractor in his employ, could result in:
 - .1 Financial penalties in the form of progress payment reduction or holdback assessments being levied against the Contractor and;
 - .2 Demand immediate removal of offending party from the site.

1.3 SECURITY PERSONNEL

- .1 Obtain and pay for the services of security personnel, employed by the Canadian Corps of Commissionaires to provide escort and security supervision of all workers during the work of this contract.
- .2 Commissionaires employed on this project must have a current Enhanced Security Clearance status issued by the Department.
- .3 Provide minimum of 1 Commissionaire to be on site at all times when work is carried out, having the following responsibilities:

- .1 Limit movement of workers to within the boundaries established by the Departmental Representative;
 - .2 Maintain security control list of workers authorized to be on site as determined by Contractor and the Departmental Representative;
 - .3 Manage the distribution and control of worker ID tags;
 - .4 Escort workers who need to circulate on site beyond the established boundaries of work, including entry into and work inside existing building.
 - .5 Escort and supervise short term visitors who need access to the work site such as for material deliveries or to conduct inspections.
- .4 Provide additional commissionaires when required to perform supervision or escort function as may be needed due to Contractor's work operations such that no worker is left unsupervised if work is required to take place inside restricted building(s) on site.
 - .5 Ensure Commissionaire(s) are present on site for entire work shift including work breaks and time period after work shifts until all workers have left site.
 - .6 Commissionaire must stay within the actual construction area and provide surveillance of all workers ensuring that security rules and requirements are obeyed and to limit movement beyond approved work areas of site.
 - .7 Commissionaire must also escort workers from approved entry locations and work area(s).
 - .8 Escort and supervision of workers by Commissionaire, when required by the Work, will be provided at all times when work of the Contract is being performed regardless of whether this is during regular business hours or beyond.
 - .9 Commissionaire shall report directly to the Departmental Representative and ensure that site security directives are obeyed by all workers.
 - .1 Empower Commissionaire with authority to remove any worker deemed non-compliant with security directives.
 - .10 Ensure Commissionaire is fitted and wears approved safety hard hat, safety footwear and other personnel protective equipment appropriate to work in accordance with applicable Occupational Health and Safety requirements specified.

1.4 SECURITY CLEARANCE REQUIREMENTS

- .1 All persons employed by Contractor or by subcontractors who will be working on site must undergo the following check:
 - .1 Personnel security clearance screening and obtain a clearance ranging from a Facility Access up to Reliability Status. This will vary as to the Contractor involvement and access requirements during and after construction.
- .2 Persons who do not have security clearance, as specified above, will not be allowed to circulate freely in restricted areas of site and must be under constant escort and surveillance by security personnel.

- .1 Restricted area defined as: areas of site beyond designated Construction area and work yard, and where required areas within other existing building(s) on site.
- .3 Departmental Representative will advise when worker security clearance has been received and whether escort and supervision is still needed for any worker.
- .4 Escort and supervision functions specified herein is still required on the project after workers having obtained security clearance.

1.5 SECURITY CLEARANCE APPLICATION

- .1 Within one week following notification of acceptance of bid, submit application form for all workers who require security clearance.
 - .1 Make application for all workers as one submission to facilitate processing and minimize delays.
- .2 To obtain Reliability Status clearance, the following information is required for each applicant:
 - .1 "Personnel Screening, Consent and Authorization Form" (Form No. TBS/SCT #330-23E (Rev. 2006/02) completed by each worker.
 - .2 Contractor Declaration to Public Works & Government Services Canada completed by Contractor attesting to having conducted an assessment of reliability for each worker applicant verifying employment and other reference data.
 - .3 Proof of applicant's identity consisting of a picture ID such as a Canadian Motor Vehicle Driver's License or other similar official ID card. Provide copy of front and back of Drivers Licence or Governmental ID.
 - .4 Proof of applicant's Canadian citizenship consisting of a provincial issued birth certificate, baptismal certificate, citizenship certificate or passport.
 - .5 Include both forms along with a clear legible photocopy of the citizenship and identity documents submitted as one complete package for each applicant.
- .3 A sample of the above mentioned forms are included at the end of this Specification Manual for reference purposes and marked Appendix "A".
 - .1 Information on filling out form TBS/SCT # 330-23E are as follows:
 - .1 Part A: by Departmental Representative Project Manager;
 - .2 Part B: by applicant. Provide full name, including middle name (not simply and initial). Ensure addresses listed represent last five (5) years of residence and each address is fully completed including postal code. Print data in clear, legible manner.
 - .3 Part C: only boxes 1, 2, 3 and 5 need to be completed, requiring applicant's initials. Name of official requested here can be Departmental Representative Project Manager or Regional Security Agent provided that Contractor submits the Security Form "A" specified above.

- .4 Fingerprinting may be required depending on level of security requirements and if previous criminal conviction exists.
- .5 Departmental Representative will provide details as to what procedures, location and time where workers must go should fingerprints are required.
- .6 Processing Time:
 - .1 The Departmental processing time to obtain all security clearances is estimated to be 4 weeks from date of receipt of required documentation.
 - .2 To avoid delays, prepare worker documentation as soon as possible, however submit documentation for each applicant as one package and send information for entire workforce as one submission. Ensure forms are fully completed, signed and that all information and photo identification is clear and legible.
 - .3 Be aware that processing time for applicants with criminal convictions may take longer and could extend to 6 months duration.
 - .1 An interview with such applicant may also be required as part of the security clearance process.
- .7 Facilitate workers security clearance process as follows:
 - .1 Prepare comprehensive list of workers who will require security clearance throughout project, including those of subcontractors.
 - .2 Provide copy of list to Departmental Representative.
 - .3 Coordinate and expedite submission of various subcontractors.
 - .4 Brief and assist applicants in preparing and submitting documentation.
 - .5 Review documentation of each applicant for completeness before submission.
 - .6 Have each worker keep a copy of their completed application form in case the initial submission gets lost.
 - .7 Submit documentation in an organized manner with transmittal letter clearly identifying project for which worker clearance is required.
- .8 Send submission(s) directly to Departmental Representative or to the approved mailing address as directed by Departmental Representative.
- .9 Persons who have not been successful in obtaining security clearance, upon documentation review by Departmental Representative, will not be allowed further access on site and cannot work on project any longer.

1.6 SECURITY PASSES

- .1 All personnel, visitors or workers requiring access on site and/or inside the existing building(s) on site beyond the public lobby require a HRMIS number issued by Departmental Representative. It is the responsibility of the Contractor and all personnel, visitors and workers to know their HRMIS number.

1.7 SECURITY CONTROL LIST

- .1 Provide a list of employee names from workforce and from subcontractors who will be present at site during the course of work.

- .2 List to include each person's name, address and telephone number.
- .3 Submit copy of list to Departmental Representative and to Security Commissionaire for control of workers.
- .4 Update list as work progresses.
- .5 Ensure that each worker can provide proof of identity upon demand, when requested by Security Personnel or Departmental Representative.

1.8 BUILDING ACCESS

- .1 Keys necessary for access to restricted areas may be issued at the discretion of the Departmental Representative. Follow all instructions in regards to use, care and disposition of all keys so issued.
- .2 Keys given to the Commissionaire for his sole possession, as determined by Departmental Representative, shall not under any circumstances be given to any worker or subcontractor.
- .3 Do not, under any circumstances, make or allow workers to make duplicates of keys issued.
- .4 At end of project, return to Departmental Representative all keys issued. Departmental Representative will deduct from final contract payment, \$25.00 for each item not returned, regardless of the reason.
- .5 Immediately report to Departmental Representative any lost, stolen or destroyed keys.

1.9 SITE SECURITY

- .1 When work must be carried out during hours beyond the work hours previously agreed upon at start of work, provide notice within 48 hours beforehand to minimize impact on security and other operations on site.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Laws, notices, permits and fees..

1.2 RELATED SECTIONS

- .1 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 LAWS, NOTICES, PERMITS AND FEES

- .1 The laws of the Place of the Work shall govern the Work.
- .2 The Department Representative shall obtain and pay for the building permit, permanent easements and rights of servitude. The Contractor shall be responsible for permits, licenses or certificates necessary for the performance of the Work which were in force at the date of executing the Agreement.
- .3 Give the required notices and comply with the laws, ordinances, rules, regulations or codes which are or become in force during the performance of the Work and which relate to the Work, to the preservation of the public health and to construction safety.
- .4 If the Contractor knowingly performs or allows work to be performed that is contrary to any laws, ordinances, rules, regulations or codes, the Contractor shall be responsible for and shall correct the violations thereof; and shall bear the costs, expenses and damages attributable to the failure to comply with the provisions of such laws, ordinances, rules, regulations or codes.
- .5 Determine detailed requirements of authorities having jurisdiction.
- .6 Pay construction damage deposits levied by municipality in connection with the issuance of a building permit.

1.4 HAZARDOUS MATERIAL DISCOVERY

- .1 If hazardous or unexpected material is encountered in course of construction work, immediately stop work and notify Department Representative.

1.5 PERSONNEL SMOKING

- .1 Comply with regulatory and Department Representative imposed smoking restrictions during execution of the Work within or outside the premises.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Quality assurance criteria.

1.2 RELATED SECTIONS

- .1 Section 01 45 00 - Quality Control.
- .2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 REFERENCES

- .1 Associated Air Balance Council (AABC): National Standards For Field Measurements and Instrumentation, Total Systems Balance, Air Distribution-Hydronics Systems.

1.4 QUALITY ASSURANCE

- .1 Provide testing organization services as specified in Section 01 45 00.
- .2 Testing organization: Current member in good standing of their respective professional or industry organization and certified to perform specified services.
- .3 Comply with applicable procedures and standards of the certification sponsoring association.
- .4 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.
- .5 Qualifications:
 - .1 Provide adequate workforce training through meetings and demonstrations.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Inspection and testing, administrative and enforcement requirements.
- .2 Tests and mix designs.
- .3 Mock-ups.
- .4 Mill tests.
- .5 Written and electronic reports.
- .6 Equipment and system adjust and balance.

1.2 RELATED SECTIONS

- .1 Section 01 43 00 - Quality Assurance.
- .2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 REFERENCES

- .1 ISO/IEC 17025-20065 - General Requirements for the Competence of Testing and Calibration Laboratories.
- .2 SCC (Standards Council of Canada).

1.4 INSPECTION BY AUTHORITY

- .1 Allow Authorities Having Jurisdiction access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection whenever portions of the Work are designated for special tests, inspections or approvals, either when described in the Contract Documents or when required by law in the Place of the Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

1.5 REVIEW BY DEPARTMENT REPRESENTATIVE

- .1 Department Representative may order any part of the Work to be reviewed or inspected if Work is suspected to be not in accordance with Contract Documents.
- .2 If, upon review such work is found not in accordance with Contract Documents, correct such Work and pay cost of additional review and correction.
- .3 If such Work is found in accordance with Contract Documents, Department Representative will pay cost of review and replacement.

1.6 ACCESS TO WORK

- .1 Allow inspection and testing agencies access to Work, off site manufacturing and fabrication plants.
- .2 Cooperate to provide reasonable access and facilities for such access.

1.7 PROCEDURES

- .1 Notify appropriate agency and Department Representative in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.8 REJECTED WORK

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Department Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other Contractor's work damaged by such removals or replacements promptly.

1.9 REPORTS

- .1 Submit Department Representative of signed inspection and test reports to one (1) electronic copy.
- .2 Provide signed paper copies to manufacturer or fabricator of material being inspected or tested.

1.10 TESTS AND MIX DESIGNS

- .1 Furnish test results and mix designs as may be requested.
- .2 The cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work shall be appraised by Department Representative and may be authorized as recoverable.

1.11 MOCK-UP

- .1 Prepare mock-up for Work specifically requested in specifications. Include for Work of all Sections required to provide mock-ups.
- .2 Prepare mock-ups for Department Representative's review with reasonable promptness and in an orderly sequence, so as not to cause any delay in Work.
- .3 Failure to prepare mock-ups in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

- .4 If requested, Department Representative will assist in preparing a schedule fixing dates for preparation.
- .5 Specification section identifies whether mock-up may remain as part of Work or if it is to be removed.

1.12 MILL TESTS

- .1 Submit mill test certificates as required of specification Sections.

1.13 EQUIPMENT AND SYSTEMS

- .1 Submit adjustment and balancing reports for building equipment and Mechanical systems.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Temporary utilities.

1.2 RELATED SECTIONS

- .1 Section 01 52 00 - Construction Facilities.

1.3 INSTALLATION AND REMOVAL

- .1 Provide temporary utilities controls in order to execute work expeditiously.
- .2 Salvage and assist in recycling products for potential reuse.
- .3 Remove from site all such work after use.
- .4 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.4 DEWATERING

- .1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.

1.5 WATER SUPPLY

- .1 Provide continuous supply of potable water for construction use.

1.6 TEMPORARY HEATING AND VENTILATION

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of Work.
 - .2 Protect Work and products against dampness and cold.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Maintain temperatures of minimum 10 degrees C in areas where construction is in progress.
- .5 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.

- .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
- .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
- .4 Ventilate storage spaces containing hazardous or volatile materials.
- .5 Ventilate temporary sanitary facilities.
- .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .6 Permanent heating system of building, may be used when available. Be responsible for damage to heating system if use is permitted.
- .7 On completion of Work for which permanent heating system is used, replace filters.
- .8 Ensure date of Substantial Performance of the Work and Warranties for heating system do not commence until entire system is in as near original condition as possible and is certified by Department Representative.
- .9 Pay costs for maintaining temporary heat, when using permanent heating system.
- .10 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
 - .1 Conform with applicable codes and standards.
 - .2 Enforce safe practices.
 - .3 Prevent abuse of services.
 - .4 Prevent damage to finishes.
 - .5 Vent direct-fired combustion units to outside.
- .11 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.7 TEMPORARY POWER AND LIGHT

- .1 Provide and pay for temporary power during construction for temporary lighting and operating of power tools, to a maximum supply of 230 volt, 30 amp.
- .2 Arrange for connection with appropriate utility company. Pay all costs for installation, maintenance and removal.
- .3 Provide and pay for temporary power for electric cranes and other equipment requiring temporary power in excess of above noted requirements.
- .4 Provide and maintain temporary lighting throughout project. Ensure level of illumination is not less than 162 lx.

1.8 TEMPORARY COMMUNICATION FACILITIES

- .1 Provide and pay for temporary telephone and high speed internet hook up, line/lines equipment necessary for own use and use of Department Representative.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Construction aids.
- .2 Office and sheds.
- .3 Parking.
- .4 Project identification.

1.2 RELATED SECTIONS

- .1 Section 01 51 00 - Temporary Utilities.
- .2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 INSTALLATION AND REMOVAL

- .1 Provide construction facilities in order to execute work expeditiously.
- .2 Remove from site all such work after use.

1.4 SCAFFOLDING

- .1 Provide and maintain ramps and ladders.

1.5 HOISTING

- .1 Provide, operate and maintain hoists required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for use thereof.
- .2 Hoists shall be operated by qualified operator.

1.6 USE OF THE WORK

- .1 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with Products.
- .2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.

1.7 CONSTRUCTION PARKING

- .1 Parking will be permitted on site provided it does not disrupt performance of Work.
- .2 Provide and maintain adequate access to project site.

1.8 OFFICES

- .1 Provide office heated to 22 degrees C, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing layout table.

- .2 Provide a clearly marked and fully stocked first-aid case in a readily available location.
- .3 Subcontractors may provide their own offices as necessary. Direct location of these offices.

1.9 EQUIPMENT, TOOL AND MATERIALS STORAGE

- .1 Provide and maintain, in a clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in a manner to cause least interference with work activities.

1.10 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take such precautions as required by local health authorities.
- .3 Except where connected to municipal sewer system, periodically remove wastes from Site.
- .4 New permanent facilities may not be used by the Contractor or Subcontractors.
- .5 Keep sanitary facilities clean and fully stocked with the necessary supplies at all times.

END OF SECTION

Part 1

General

1.1 SECTION INCLUDES

- .1 Site enclosure.
- .2 Guardrails and barriers.
- .3 Weather enclosures.
- .4 Dust tight barriers.
- .5 Protection for off-site and public property.
- .6 Protection of applied finishes.
- .7 Protection of surrounding Work.

1.2 RELATED SECTIONS

- .1 Section 01 51 00 - Temporary Utilities.
- .2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 INSTALLATION AND REMOVAL

- .1 Provide temporary controls in order to execute Work expeditiously.
- .2 Remove from site all such work after use.

1.4 SITE ENCLOSURE

- .1 Erect temporary site enclosure using new 1.2 m high snow fence wired to rolled steel "T" bar fence, posts spaced at 2.4 m on centre.
 - .1 Provide one (1) lockable truck gate.
 - .2 Maintain fence in good repair.
- .2 Protect from damage by equipment and construction procedures.

1.5 GUARD RAILS AND BARRIERS

- .1 Provide as required by governing authorities.

1.6 WEATHER ENCLOSURES

- .1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.
- .2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .3 Design enclosures to withstand wind pressure and snow loading.

1.7 DUST TIGHT BARRIERS

- .1 Provide dust tight barriers and screens or insulated partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public.
- .2 Maintain and relocate protection until such work is complete.

1.8 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred.

1.9 PROTECTION OF APPLIED FINISHES

- .1 Provide protection for finished and partially finished surfaces and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with Consultant locations and installation schedule three (3) days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

1.10 PROTECTION OF SURROUNDING WORK

- .1 Provide protection for finished and partially finished Work from damage.
- .2 Provide necessary cover and protection.
- .3 Be responsible for damage incurred due to lack of or improper or inappropriate protection.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Informational and warning devices.
- .2 Protection and control of public traffic.
- .3 Operational requirements.

1.2 RELATED SECTIONS

- .1 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 REFERENCES

- .1 TAC (Transportation Association of Canada) - Manual of Uniform Traffic Control Devices, 2008 Update.
- .2 Municipal guidelines and regulations enforceable in the Place of the Work.

1.4 ACCESS TO SITE

- .1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

1.5 PUBLIC TRAFFIC FLOW

- .1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect the public.

1.6 PROTECTION OF PUBLIC TRAFFIC

- .1 Comply with requirements of Acts, Regulations and By-Laws in force for regulation of traffic or use of roadways upon or over which it is necessary to carry out Work or haul materials or equipment.
- .2 When working on travelled way:
 - .1 Place equipment in position to present minimum of interference and hazard to traveling public.
 - .2 Keep equipment units as close together as working conditions permit and preferably on same side of travelled way.
 - .3 Do not leave equipment on travelled way overnight.
- .3 Do not close any lanes of road without approval of authority having jurisdiction. Before re-routing traffic erect suitable signs and devices in accordance with instructions contained in UTCD.
- .4 Provide and maintain road access and egress to property fronting along Work under Contract and in other areas as indicated, unless other means of road access exist that meet approval of Department Representative.

1.7 INFORMATIONAL AND WARNING DEVICES

- .1 Provide and maintain signs, flashing warning lights and other devices required to indicate construction activities or other temporary and unusual conditions resulting from Project Work which requires road user response.
- .2 Supply and erect signs, delineators, barricades and miscellaneous warning devices as specified in TAC manual.
- .3 Place signs and other devices in locations recommended in TAC manual.
- .4 Meet with Department Representative prior to commencement of Work to prepare list of signs and other devices required for project. If situation on site changes, revise list to approval of Department Representative.
- .5 Continually maintain traffic control devices in use by:
 - .1 Checking signs daily for legibility, damage, suitability and location. Clean, repair or replace to ensure clarity and reflectance.
 - .2 Removing or covering signs which do not apply to conditions existing from day to day.

1.8 CONTROL OF PUBLIC TRAFFIC

- .1 Provide competent flag persons, trained in accordance with, and properly equipped as specified in municipal guidelines for the following situations:
 - .1 When public traffic is required to pass working vehicles or equipment which block all or part of travelled roadway.
 - .2 When it is necessary to institute one-way traffic system through construction area or other blockage where traffic volumes are heavy, approach speeds are high and traffic signal system is not in use.
 - .3 When workmen or equipment are employed on travelled way over brow of hills, around sharp curves or at other locations where oncoming traffic would not otherwise have adequate warning.
 - .4 Where temporary protection is required while other traffic control devices are being erected or taken down.
 - .5 For emergency protection when other traffic control devices are not readily available.
 - .6 In situations where complete protection for workers, working equipment and public traffic is not provided by other traffic control devices.
 - .7 At each end of restricted sections where pilot cars are required.
 - .8 Delays to public traffic due to contractor's operators: maximum fifteen (15) minutes.

1.9 FIRE ROUTES

- .1 Maintain access to property including overhead clearances for use by emergency response vehicles.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Create an erosion and sediment control plan.
- .2 Prevent loss of soil during construction by storm water runoff and wind erosion.
- .3 Protect stockpiled topsoil.
- .4 Prevent sedimentation of storm water and receiving streams.
- .5 Prevent pollution of the air with dust and particulate matter.

1.2 RELATED SECTIONS

- .1 Section 31 11 00 - Clearing and Grubbing
- .2 Section 31 23 16 - Excavating, Trenching, and Backfilling

1.3 REFERENCES

- .1 EPA 832/R-92-005 - Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices, September 1992.
- .2 Local erosion and sediment control guidelines.

1.4 DEFINITIONS

- .1 Erosion: Deterioration, displacement, or transportation of land surface by wind or water, intensified by land-clearing practices related to construction activities.
- .2 Rain or Rain Storm: An event defined causing the pooling of water on road or other impervious surfaces.
- .3 Sediment: Particulate matter transported and deposited as a layer of solid particles within a body of water.
- .4 Snow Melt: An event in snow conditions when the temperature is above 0 degrees C or when environmental conditions causing snow on the ground to melt.

1.5 SUBMITTALS

- .1 Provide requested information in accordance with Section 01 33 00 – Submittals.
- .2 Provide within seven (7) days of date established for commencement of the Work.
- .3 Application for Payment: Concurrent with each application, provide the following Inspection Log information:
 - .1 Weekly inspection record.
 - .2 Report damages or deficiencies and maintenance of erosion and sediment control measures.

- .3 Identify and address standing rainwater or snowmelt conditions.

Part 2 Products

2.1 SILT FENCING

- .1 Posts: Steel "T" cross section, of lengths as required.
- .2 Geotextile: Woven polypropylene filter fabric, resistant to ultra-violet degradation.

2.2 STOCKPILING

- .1 Prevent cleared topsoil and excavated earth stockpiled on site from being eroded by rain storm, snow melt or wind.
- .2 Install silt fencing.
- .3 Maintain silt fencing at a height of no less than 400 mm above grade, and no greater than 800 mm.
- .4 Extend geotextile filter fabric 150 mm below grade, and return 150 mm towards the opposite direction of flow.
- .5 Space posts not further than 1800 mm apart.
- .6 Limit operation of vehicles on site to paved surfaces or temporary gravel surfaces in order to avoid the disturbing soil.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Implementation of a construction Indoor Air Quality (IAQ) Management Plan, on site.
- .2 IAQ testing.

1.2 RELATED SECTIONS

- .1 Section 01 21 00 - Allowances: Cash Allowance for IAQ testing.
- .2 Section 01 74 00 - Cleaning and Waste Processing.
- .3 Section 01 75 19 - Testing, Adjusting and Balancing.
- .4 Section 23 31 13.01 - Metal Ducts
- .5 Section 23 33 00 - Air Duct Accessories.
- .6 Section 23 44 00 - HVAC Air Filtration.

1.3 DEFINITIONS

- .1 IAQ: Indoor Air Quality.
- .2 MERV: Minimum Efficiency Reporting Value.

1.4 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 52.2-1999: Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA), 6th Edition - IAQ Guidelines for Occupied Buildings Under Construction.
- .3 Indoor Air Quality - Health Canada.

1.5 SUBMITTALS

- .1 Section 01 33 00: Submission procedures.
- .2 Concurrent with each Application for Payment, provide the following:
 - .1 Weekly inspection record of damage or deficiencies and maintenance of IAQ management measures.

Part 2 Products

2.1 AIR FILTRATION MEDIA

- .1 Pleated Synthetic Filtration Media: MERV of 13 as determined by ASHRAE 52.2.

Part 3 Execution

3.1 INDOOR AIR QUALITY DURING CONSTRUCTION

- .1 Implement and maintain an Indoor Air Quality (IAQ) Management Plan during construction and facility pre-occupancy:
 - .1 Meet or exceed SMACNA IAQ Guidelines for Occupied Buildings Under Construction.
 - .2 Protect building materials stored and installed on site from damage caused by exposure to moisture.
 - .3 Prohibit smoking at all indoor locations and adjacent to door openings.
 - .4 For use of permanent heating, cooling, and ventilating systems during the construction phase as specified in Section 01 51 00, install air filtration media at each inlet to a return air duct for the air handling system used during construction.
 - .5 Regularly inspect conditions on site to ensure that IAQ Management measures are being correctly implemented and maintained:
 - .1 Verify filtration media is intact.
 - .2 Observe materials are adequately protected from exposure to moisture and debris.
 - .3 Ensure spaces and voids to be concealed by construction are free of debris prior to enclosing them.
 - .4 Remove standing water which accumulated on surfaces or within components.

3.2 FLUSH-OUT

- .1 Building flush prior to occupancy.
 - .1 On termination of construction and interior finishes and furnishings have been installed, but prior to the building being occupied, conduct a full building flush for no less than fourteen (14) days.

3.3 IAQ TESTING

- .1 IAQ testing prior to occupancy.
 - .1 After construction and interior finishes and furnishings have been installed, but prior to the building being occupied, engage a qualified independent testing and inspecting agency to conduct baseline indoor air quality testing.
 - .2 Provide testing consistent with protocols outlined by CEPA and demonstrate that contaminants listed below do not exceeded the limits indicated.
 - .1 Particulate matter (PM10): Maximum 50 micrograms per cu m.
 - .2 Formaldehyde: Maximum 50 parts per billion.
 - .3 Total Volatile Organic Compounds (VOCs): Maximum 500 micrograms per cu m.

- .4 Carbon monoxide: Maximum 9 parts per million, and no greater than 2 parts per million above outdoor levels.
- .3 Complete testing in one (1) day, over a minimum four (4) hour period for each sample, and during times when the building would normally expect to be occupied.
- .4 Collect one (1) sample for each 2300 sq m, or part thereof of floor area, collect a minimum of one (1) sample for each occupied floor.
- .5 Collect samples from a height between 1.2 m and 2.1 m above the finished floor elevation.
- .6 Building ventilation systems and equipment should be operational prior to, and during the collection of test samples. Indoor climate conditions should be similar to conditions expected when the building is occupied.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Product quality, availability, storage, handling, protection, and transportation.
- .2 Product substitution procedures.
- .3 Manufacturer's instructions.
- .4 Quality of Work, coordination and fastenings.

1.2 RELATED SECTIONS

- .1 Section 01 62 00 - Product Exchange Procedures.
- .2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 TERMINOLOGY

- .1 New: Produced from new materials.
- .2 Re-newed: Produced or rejuvenated from an existing material to like-new condition to serve a new or existing service.
- .3 Defective: A condition determined exclusively by the Department Representative.

1.4 PRODUCT QUALITY

- .1 Products, materials, equipment, parts or assemblies (referred to as Products) incorporated in Work: New, not damaged or defective, of best quality (compatible with specification requirements) for purpose intended. If requested, provide evidence as to type, source and quality of Products provided.
- .2 Defective Products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective Products at own expense and be responsible for delays and expenses caused by rejection.
- .3 Should any dispute arise as to quality or fitness of Products, decision rests strictly with Department Representative.
- .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .5 Permanent labels, trademarks and nameplates on Products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.5 AVAILABILITY

- .1 Immediately upon signing Contract, review Product delivery requirements and anticipate foreseeable supply delays for any items.
- .2 If delays in supply of Products are foreseeable, notify Department Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.
- .3 In event of failure to notify Department Representative at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Department Representative reserves right to substitute more readily available Products of similar character, at no increase in Contract Price or Contract Time.

1.6 STORAGE AND PROTECTION

- .1 Store and protect Products in accordance with manufacturers' written instructions.
- .2 Store with seals and labels intact and legible.
- .3 Store sensitive Products in weather tight, climate controlled, enclosures in an environment favourable to Product.
- .4 For exterior storage of fabricated Products, place on sloped supports above ground.
- .5 Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of Products.
- .6 Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- .7 Provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.
- .8 Arrange storage of Products to permit access for inspection. Periodically inspect to verify Products are undamaged and are maintained in acceptable condition.

1.7 TRANSPORTATION AND HANDLING

- .1 Transport and handle Products in accordance with manufacturer's written instructions.
- .2 Promptly inspect shipments to ensure that Products comply with requirements, quantities are correct, and Products are undamaged.
- .3 Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

1.8 PRODUCT CHANGES

- .1 Change in Product/Products: Submit request for substitution or alternative in accordance with Section 01 62 00.

1.9 EXISTING UTILITIES

- .1 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

1.10 MANUFACTURER'S WRITTEN INSTRUCTIONS

- .1 Unless otherwise indicated in specifications, install or erect Products to manufacturer's written instructions. Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.
- .2 Notify Department Representative in writing, of conflicts between specifications and manufacturer's instructions, so that Department Representative may establish course of action.
- .3 Improper installation or erection of Products, due to failure in complying with these requirements, authorizes Department Representative to require removal and re-installation at no increase in Contract Price or Contract Time.

1.11 QUALITY OF WORK

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Department Representative if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Department Representative reserves right to require dismissal from site any workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Department Representative, whose decision is final.

1.12 COORDINATION

- .1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.13 CONCEALMENT

- .1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation, inform Department Representative if there is interference. Install as directed by Department Representative.

1.14 REMEDIAL WORK

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.

- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.15 LOCATION OF FIXTURES

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform Department Representative of conflicting installation. Install as directed.

1.16 FASTENINGS

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.17 FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use Type 304 or 316 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.18 PROTECTION OF WORK IN PROGRESS

- .1 Prevent overloading of any part of the Project.
- .2 Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated, without written approval of Department Representative.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Substitutions.
- .2 Alternatives.
- .3 Separate prices.

1.2 RELATED SECTIONS

- .1 Section 01 21 00 - Allowances.
- .2 Section 01 29 00 - Payment Procedures.
- .3 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 SUBSTITUTIONS

- .1 Instructions to Bidders specify time restrictions for submitting requests for Substitutions during the bidding period to requirements specified in this section.
- .2 Department Representative will consider requests for Substitutions only within fifteen (15) days after date of Department Representative-Contractor Agreement.
- .3 Substitutions may be considered when a Product becomes unavailable through no fault of the Contractor.
- .4 Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- .5 A request constitutes a representation that the Bidder:
 - .1 Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified Product.
 - .2 Will provide the same warranty for the Substitution as for the specified Product.
 - .3 Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Department Representative.
 - .4 Waives claims for additional costs or time extension which may subsequently become apparent.
 - .5 Will reimburse Department Representative for review or redesign services associated with re-approval by authorities.
- .6 Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- .7 Substitution Submittal Procedure:

- .1 Submit a written request for Substitution for consideration. Limit each request to one (1) proposed Substitution.
- .2 Submit shop drawings, product data, and certified test results attesting to the proposed Product equivalence. Burden of proof is on proposer.
- .3 The Department Representative will notify Contractor in writing of decision to accept or reject request.

1.4 ALTERNATIVES

- .1 Accepted Alternatives will be identified in Department Representative-Contractor Agreement.
- .2 Submit alternatives identifying the effect on adjacent or related components.
- .3 Alternatives quoted on Bid Forms will be reviewed and accepted or rejected at the Department Representative's option. Accepted alternatives will be identified in the Department Representative-Contractor Agreement.
- .4 Coordinate related work and modify surrounding work to integrate the Work of each alternative.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Field engineering survey services to measure and stake site.
- .2 Recording of subsurface conditions found.
- .3 Survey services to determine measurement inverts for the Work.
- .4 Requirements and limitations for cutting and patching the Work.

1.2 RELATED SECTIONS

- .1 Section 01 62 00 - Product Exchange Procedures.
- .2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 REFERENCES

- .1 Department Representative's identification of existing survey control points and property limits.

1.4 SUBMITTALS

- .1 Submit name and address of Surveyor to Department Representative.
- .2 On request of Department Representative, submit documentation to verify accuracy of field engineering work.
- .3 Submit certificate signed by surveyor certifying and noting those elevations and locations of completed Work that conform and do not conform with Contract Documents.

1.5 QUALIFICATIONS OF SURVEYOR

- .1 Qualified registered land surveyor, licensed to practise in the Place of the Work, acceptable to Department Representative.

1.6 SURVEY REFERENCE POINTS

- .1 Existing base horizontal and vertical control points are designated on Drawings.
- .2 Locate, confirm and protect control points prior to starting site Work. Preserve permanent reference points during construction.
- .3 Make no changes or relocations without prior written notice to Department Representative.
- .4 Report to Department Representative when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
- .5 Require surveyor to replace control points in accordance with original survey control.

1.7 SURVEY REQUIREMENTS

- .1 Establish two (2) permanent bench marks on site, referenced to established bench marks by survey control points.
- .2 Record locations, with horizontal and vertical data in Project Record Documents.
- .3 Establish lines and levels, locate and lay out, by instrumentation.
- .4 Stake for grading.
- .5 Stake slopes and berms.
- .6 Establish pipe invert elevations.
- .7 Stake batter boards for foundations.
- .8 Establish foundation column locations and floor elevations.
- .9 Establish lines and levels for mechanical and electrical work.

1.8 SUBSURFACE CONDITIONS

- .1 Promptly notify Department Representative in writing if discovered surface or subsurface conditions at Place of Work differ materially from those indicated in Contract Documents.
- .2 Advise the Department Representative of a reasonable assumption of probable conditions when determined.
- .3 After prompt investigation, should Department Representative determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes or Change Orders set out in Section 01 29 00.

1.9 EXAMINATION

- .1 Inspect existing conditions, including elements or adjacent Work subject to irregularities, damage, movement, including Work during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of the Work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.

1.10 PREPARATION

- .1 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .2 Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.

1.11 EXISTING SERVICES

- .1 Before commencing work, establish location and extent of service lines in area of Work and notify Department Representative of findings.
- .2 Remove abandoned service lines within 2 m of structures. Cap or seal lines at cut-off points as directed by Department Representative.

1.12 LOCATION OF EQUIPMENT AND FIXTURES

- .1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.
- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3 Inform Department Representative of impending installation and obtain approval for actual location.
- .4 Submit field drawings to indicate relative position of various services and equipment when required by Department Representative.

1.13 SURVEY RECORD

- .1 Maintain a complete, accurate log of control and survey work as it progresses.
- .2 Record locations of maintained, re-routed and abandoned service lines.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Submittal requirements associated with connecting to new and existing facilities.
- .2 Execution requirements for all Work.

1.2 RELATED SECTIONS

- .1 Section 01 70 00 - Examination and Preparation.
- .2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 SUBMITTALS - ATTACHING TO EXISTING WORK

- .1 Submit written request in advance of cutting or alteration which affects:
 - .1 Structural integrity of any element of Project.
 - .2 Integrity of weather-exposed or moisture-resistant elements.
 - .3 Efficiency, maintenance, or safety of any operational element.
 - .4 Visual qualities of sight-exposed elements.
 - .5 Work of Department Representative or separate contractor.
- .2 Include in request:
 - .1 Identification of Project.
 - .2 Location and description of affected Work.
 - .3 Statement on necessity for cutting or alteration.
 - .4 Description of proposed Work, and products to be used.
 - .5 Alternatives to cutting and patching.
 - .6 Effect on Work of Department Representative or separate contractor.
 - .7 Written permission of affected separate contractor.
 - .8 Date and time work will be executed.

1.4 TOLERANCES

- .1 Monitor fabrication and installation tolerance control of Products to produce acceptable Work.
- .2 Do not permit tolerances to accumulate beyond effective or practical limits.
- .3 Comply with manufacturers' tolerances. In case of conflict between manufacturers' tolerances and Contract Documents, request clarification from Department Representative before proceeding.
- .4 Adjust Products to appropriate dimensions; position and confirm tolerance acceptability, before permanently securing Products in place.

1.5 EXECUTION

- .1 Execute cutting, fitting, and patching to complete the Work.
- .2 Perform all required excavation and fill to complete the Work.
- .3 Fit several parts together, to integrate with other Work.
- .4 Uncover Work to install ill-timed Work.
- .5 Remove and replace defective or non-conforming Work.
- .6 Remove samples of installed Work for testing, if not designated in the respective Section as remaining as part of the Work.
- .7 Provide openings in non-structural elements of Work for penetrations of electrical and associated Work. Limit opening dimensions to minimal sizes required, and performed in a neat and clean fashion.
- .8 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .9 Employ competent workers to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .10 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry or concrete work without prior approval.
- .11 Restore work with new products in accordance with requirements of Contract Documents.
- .12 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .13 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material, for full thickness of the constructed element.
- .14 Re-finish surfaces to match adjacent finishes: For continuous surfaces re-finish to nearest intersection; for an assembly, re-finish entire unit.
- .15 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Requirements and limitations for cutting and patching of Work.

1.2 RELATED SECTIONS

- .1 Section 01 10 00 - Summary of Work: Work by Department Representative.
- .2 Section 01 32 00 - Construction Progress Documentation: Submittals and scheduling.
- .3 Section 01 61 00 - Product Requirements.
- .4 Section 01 62 00 - Product Exchange Procedures: Product options and substitutions.
- .5 Section 07 84 00 - Firestopping.
- .6 Individual Product Specification Sections:
 - .1 Cutting and patching incidental to work of the section.
 - .2 Advance notification to other sections of openings required in Work of those sections.
 - .3 Limitations on cutting structural members.

1.3 SUBMITTALS

- .1 Submit written request in advance of cutting or alteration which affects:
 - .1 Structural integrity of any element of Project.
 - .2 Integrity of weather exposed or moisture resistant element.
 - .3 Efficiency, maintenance, or safety of any operational element.
 - .4 Visual qualities of sight exposed elements.
 - .5 Work of Department Representative or separate contractor.
- .2 Include in request:
 - .1 Identification of Project.
 - .2 Location and description of affected Work.
 - .3 Necessity for cutting or alteration.
 - .4 Description of proposed Work and Products to be used.
 - .5 Alternatives to cutting and patching.
 - .6 Effect on work of Department Representative or separate contractor.
 - .7 Written permission of affected separate contractor.
 - .8 Date and time work will be executed.

Part 2 Products

2.1 MATERIALS

- .1 Primary Products: Those required for original installation.
- .2 Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 62 00.

Part 3 Execution

3.1 EXAMINATION

- .1 Examine existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering existing Work, assess conditions affecting performance of work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.

3.2 PREPARATION

- .1 Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.
- .2 Provide protection from elements for areas which may be exposed by uncovering work.
- .3 Maintain excavations free of water.

3.3 CUTTING

- .1 Execute cutting and fitting including excavation and fill to complete the Work.
- .2 Uncover work to install improperly sequenced work.
- .3 Remove and replace defective or non-conforming work.
- .4 Remove samples of installed work for testing when requested.
- .5 Provide openings in the Work for penetration of mechanical and electrical work.
- .6 Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- .7 Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

3.4 PATCHING

- .1 Execute patching to complement adjacent Work.
- .2 Fit Products together to integrate with other Work.
- .3 Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.
- .4 Employ original installer to perform patching for weather exposed and moisture resistant elements, and sight-exposed surfaces.

- .5 Restore work with new Products in accordance with requirements of Contract Documents.
- .6 Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .7 At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material to maintain fire separation, to full thickness of the penetrated element.
- .8 Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Progressive cleaning.
- .2 Cleaning prior to acceptance.

1.2 RELATED SECTIONS

- .1 Section 01 74 20 - Waste Managing and Disposal.
- .2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

Part 2 Products

2.1 CLEANING MATERIALS

- .1 Cleaning Agents and Materials: Low VOC content.

Part 3 Execution

3.1 PROGRESSIVE CLEANING

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Department Representative or other Contractors.
- .2 Remove waste materials from site at regularly scheduled times or dispose of as directed by Department Representative. Do not burn waste materials on site, unless approved by Department Representative.
- .3 Clear snow and ice from area of construction, bank or pile snow in designated areas only.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Containers:
 - .1 Provide on-site steel framed, hinged lid containers for collection of waste materials and debris.
 - .2 Provide and use clearly marked, separate bins for recycling.
 - .3 Refer to Section 01 74 20.
- .6 Remove waste material and debris from site and deposit in waste container at end of each working day.
- .7 Dispose of waste materials and debris at Department Representative designated dumping areas.

- .8 Clean interior areas prior to start of finish work, and maintain areas free of dust and other contaminants during finishing operations.
- .9 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .10 Provide adequate ventilation during use of volatile or noxious substances. Use of enclosure ventilation systems is not permitted for this purpose.
- .11 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

3.2 CLEANING PRIOR TO ACCEPTANCE

- .1 Prior to applying for Substantial Performance of the Work, remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review, remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste products and debris other than that caused by Department Representative or other Contractors.
- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Department Representative. Do not burn waste materials on site, unless approved by Department Representative.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .8 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fittings, walls, floors etc..
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .11 Clean and polish surface finishes, as recommended by manufacturer.
- .12 Inspect finishes, fittings and equipment and ensure specified workmanship and operation.
- .13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .14 Remove dirt and other disfiguration from exterior surfaces.

- .15 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .16 Sweep and wash clean paved areas.
- .17 Clean equipment and fixtures to a sanitary condition; clean or replace filters of mechanical equipment.
- .18 Clean roof surfaces, down-spouts, and drainage components.
- .19 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .20 Remove snow and ice from access to facilities.

3.3 FINAL PRODUCT CLEANING

- .1 Execute final cleaning prior to final project assessment. Refer to Section 01 74 00.
- .2 Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- .3 Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- .4 Replace filters of operating equipment.
- .5 Clean site; sweep paved areas, rake clean landscaped surfaces.
- .6 Remove waste and surplus materials, rubbish, and construction facilities from the site.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Waste goals.
- .2 Waste management plan.
- .3 Waste management plan implementation.
- .4 Disposal of waste.
- .5 Forms for documenting program.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 00 – Cleaning and Waste Processing.
- .3 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 DEFINITIONS

- .1 Clean Waste: Untreated and unpainted; not contaminated with oils, solvents, sealants or similar materials.
- .2 Construction and Demolition Waste: Solid wastes typically including but not limited to, building materials, packaging, trash, debris, and rubble resulting from construction, re-modelling, repair and demolition operations.
- .3 Hazardous: Exhibiting the characteristics of hazardous substances including, but not limited to, ignitability, corrosiveness, toxicity or reactivity.
- .4 Non-hazardous: Exhibiting none of the characteristics of hazardous substances, including, but not limited to, ignitability, corrosiveness, toxicity, or reactivity.
- .5 Non-toxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- .6 Recyclable: The ability of a product or material to be recovered at the end of its life cycle and re-manufactured into a new product for reuse by others.
- .7 Recycle: To remove a waste material from the Project site to another site for re-manufacture into a new product for reuse by others.
- .8 Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .9 Return: To give back reusable items or unused products to vendors for credit.
- .10 Reuse: To reuse a construction waste material in some manner on the Project site.

- .11 Salvage: To remove a waste material from the Project site to another site for resale or reuse by others.
- .12 Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- .13 Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
- .14 Toxic: Poisonous to humans either immediately or after a long period of exposure.
- .15 Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- .16 Volatile Organic Compounds (VOC's): Chemical compounds common in and emitted by many building products over time through outgassing:
 - .1 Solvents in paints and other coatings.
 - .2 Wood preservatives; strippers and household cleaners.
 - .3 Adhesives in particle board, fibreboard, and some plywood; and foam insulation.
 - .4 When released, VOC's can contribute to the formation of smog and can cause respiratory tract problems, headaches, eye irritations, nausea, damage to the liver, kidneys, and central nervous system, and possibly cancer.
- .17 Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.
- .18 Waste Management Plan: A Project-related plan for the collection, transportation, and disposal of the waste generated at the construction site. The purpose of the plan is to ultimately reduce the amount of material being landfilled.

1.4 SUBMITTAL

- .1 Section 01 33 00: Submission procedures.
- .2 Prepare and submit the following submittals prior to project start-up:
 - .1 Submit an electronic copy of completed Waste Audit.
 - .2 Submit an electronic copy of completed Waste Reduction Work Plan.

1.5 DEPARTMENT REPRESENTATIVE WASTE MANAGEMENT GOALS

- .1 Department Representative has established this Project is to generate the least amount of waste possible. This requires that construction processes ensure as little waste as possible, either due to error, poor planning, breakage, mishandling, contamination, or other factors.
- .2 Department Representative recognizes that waste in any project is inevitable, but indicates that as much of the waste materials as economically feasible. Reused, salvage, or recycle as required.
- .3 Minimize waste disposal to landfills.

1.6 STORAGE, HANDLING AND PROTECTION

- .1 Store, materials to be reused, recycled and salvaged in locations as directed by Department Representative.
- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .3 Protect, stockpile, store and catalogue salvaged items.
- .4 Separate non-salvageable materials from salvaged items. Transport and deliver non-salvageable items to licensed disposal facility.
- .5 Protect structural components not removed for demolition from movement or damage.
- .6 Support affected structures. If safety of building is endangered, cease operations and immediately notify Department Representative.
- .7 Protect surface drainage, storm sewers, sanitary sewers, and utility services from damage and blockage.

1.7 SCHEDULING

- .1 Coordinate work with other activities at site to ensure timely and orderly progress of the work.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 PREPARATION

- .1 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

3.2 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises.
- .2 Maintain security measures established by existing facility.
- .3 Provide temporary security measures as approved by Department Representative.

3.3 DISPOSAL OF WASTE

- .1 Burying of rubbish and waste materials is prohibited unless approved by authority having jurisdiction.
- .2 Disposal of waste and mineral spirits into waterways, storm, or sanitary sewers is prohibited.

3.4 CLEANING

- .1 Remove tools and waste materials on completion of work, leave work area in clean and orderly condition.
- .2 Clean-up work area as work progresses.
- .3 Source separate materials to be reused/recycled into specified sort areas.

3.5 SPECIAL PROGRAMS

- .1 Be responsible for final implementation of programs involving tax credits or rebates or similar incentives related to recycling, if applicable to the Project.
- .2 Revenues or other savings obtained for recycling or returns to accrue to Contractor.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Inspections and declarations.
- .2 Closeout submittals.
- .3 Operation and maintenance manual format.
- .4 Contents each volume.
- .5 Recording actual site conditions.
- .6 Record (as-built) documents and samples.
- .7 Final survey.
- .8 Warranties and bonds.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Quality Control.
- .3 Section 01 79 00 - Demonstration and Training.
- .4 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 INSPECTIONS AND DECLARATIONS

- .1 Contractor's Inspection: Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify Department Representative in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.
 - .2 Request Department Representative's Inspection.
- .2 Department Representative's Inspection: Department Representative and Contractor will perform inspection of Work to identify defects or deficiencies. Correct defective and deficient Work accordingly.
- .3 Completion: Submit written certificate that following have been performed:
 - .1 Work has been completed and inspected for compliance with Contract Documents.
 - .2 Defects have been corrected and deficiencies have been completed.
 - .3 Equipment and systems have been tested, adjusted and balanced and are fully operational.
 - .4 Certificates required by authorities having jurisdiction have been submitted.

- .5 Operation of systems have been demonstrated to Department Representative's personnel.
- .6 Work is complete and ready for Final Inspection.
- .4 Final Inspection: When items noted above are completed, request final inspection of Work by Department Representative, and Project Manager. If Work is deemed incomplete by Department Representative, complete outstanding items and request re-inspection.
- .5 Declaration of Substantial Performance: when Department Representative consider deficiencies and defects have been corrected and it appears requirements of Contract have been substantially performed, make application for Substantial Performance of the Work.
- .6 Commencement of Warranty Periods: the date of Substantial Performance of the Work shall be the date for commencement of the warranty period.
- .7 Final Payment: When Department Representative consider final deficiencies and defects have been corrected and it appears requirements of Contract have been completed, make application for final payment.
- .8 Payment of Hold-back: After issuance of certificate of Substantial Performance of the Work, submit an application for payment of hold-back amount.

1.4 CLOSEOUT SUBMITTALS

- .1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .2 Copy will be returned after final inspection with Department Representative's comments.
- .3 Revise content of documents as required prior to final submittal.
- .4 Four (4) weeks prior to Substantial Performance of the Work, submit to the Department Representative one (1) draft of operating and maintenance manuals in Canadian English for review and comment. Submit one (1) electronic copy and three (3) hardcopies of final operating and maintenance manuals.
- .5 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .6 If requested, furnish evidence as to type, source and quality of products provided.
- .7 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .8 Pay costs of transportation.

1.5 OPERATION AND MAINTENANCE MANUAL FORMAT

- .1 Organize data in the form of an instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.

- .3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.
- .4 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by systems under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: Manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

1.6 CONTENTS - EACH VOLUME

- .1 Table of Contents: Provide:
 - .1 Title of project.
 - .2 Date of submission.
 - .3 Names, addresses, and telephone numbers of Department Representative and Contractor with name of responsible parties.
 - .4 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system, list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00.
- .4 Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Certificate of Acceptance: Relevant certificates issued by authorities having jurisdiction, including pressure vessel acceptance.
- .6 Training: Refer to Section 01 79 00.

1.7 RECORDING ACTUAL SITE CONDITIONS

- .1 Record information on set of black line opaque drawings, and within the Project Manual, provided by Department Representative.
- .2 Annotate with coloured felt tip marking pens, maintaining separate colours for each major system, for recording changed information.
- .3 Record information concurrently with construction progress. Do not conceal Work of the Project until required information is accurately recorded.
- .4 Contract drawings and shop drawings: legibly mark each item to record actual construction, including:

- .1 Measured depths of elements of foundation in relation to finish first floor datum.
- .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
- .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
- .4 Field changes of dimension and detail.
- .5 Changes made by change orders.
- .6 Details not on original Contract Drawings.
- .7 References to related shop drawings and modifications.
- .5 Specifications: legibly mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: Maintain manufacturer's certifications required by individual specifications sections.

1.8 RECORD (AS-BUILT) DOCUMENTS AND SAMPLES

- .1 In addition to requirements in General Conditions, maintain at the site for the Department Representative, one (1) record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to the Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
- .2 Store as-built documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.
- .3 Label as-built documents and file in accordance with section number listings in List of Contents of the Project Manual. Label each document "AS-BUILT DOCUMENTS" in neat, large, printed letters.
- .4 Maintain as-built documents in clean, dry and legible condition. Do not use as-built documents for construction purposes.
- .5 Keep as-built documents and samples available for inspection by Department Representative.

1.9 RECORD DOCUMENTS

- .1 The Department Representative is responsible for transferring "As Built" construction information, provided by Contractor, on to AutoCAD electronic files for submission to Department Representative as 'Record Documents'.

1.10 WARRANTIES AND BONDS

- .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
- .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten (10) days after completion of the applicable item of work. All warranties must be assigned to the Departmental Representative.
- .4 Except for items put into use with Department Representative's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.
- .5 Verify that documents are in proper form, contain full information, and are notarized.
- .6 Co-execute submittals when required.
- .7 Retain warranties and bonds until time specified for submittals.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Equipment and systems.
- .2 Materials and finishes.
- .3 Spare parts.
- .4 Maintenance manuals.
- .5 Special tools.
- .6 Storage, handling and protection.

1.2 RELATED SECTIONS

- .1 Section 01 45 00 - Quality Control.
- .2 Section 01 78 40 – Maintenance Requirements.
- .3 Section 01 91 00 - Commissioning.

1.3 EQUIPMENT AND SYSTEMS

- .1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.

- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 45 00 and 01 91 13 and 01 91 00.
- .15 Include test and balancing reports as specified in Section 01 45 00.
- .16 Additional requirements: As specified in individual specification sections.

Part 2 Products

2.1 MATERIALS AND FINISHES

- .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. .
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Building Envelope: include copies of drawings of building envelope components, illustrating the interface with similar or dissimilar items to provide an effective air, vapour and thermal barrier between indoor and outdoor environments. Include an outline of requirements for regular inspections and for regular maintenance to ensure that on-going performance of the building envelope will meet the initial building envelope criteria.
- .5 Additional Requirements: as specified in individual specifications sections.

2.2 SPARE PARTS

- .1 Provide spare parts, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Receive and catalogue all items. Submit inventory listing to Department Representative. Include approved listings in Maintenance Manual.
- .4 Obtain receipt for delivered products and submit prior to final payment.

2.3 MAINTENANCE MATERIALS

- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Receive and catalogue all items. Submit inventory listing to Department Representative. Include approved listings in Maintenance Manual.

- .4 Obtain receipt for delivered products and submit prior to final payment.

2.4 SPECIAL TOOLS

- .1 Provide special tools, in quantities specified in individual specification section.
- .2 Provide items with tags identifying their associated function and equipment.
- .3 Receive and catalogue all items. Submit inventory listing to Department Representative. Include approved listings in Maintenance Manual.

Part 3 Execution

3.1 DELIVER TO SITE

- .1 Deliver to site; place and store.

3.2 STORAGE, HANDLING AND PROTECTION

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and to satisfaction of Department Representative.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Procedures for demonstration and instruction of Products, equipment and systems to Department Representative's personnel.
- .2 Seminars and demonstrations.

1.2 RELATED SECTIONS

- .1 Section 01 91 00 - Commissioning.
- .2 This section describes requirements applicable to all Sections within Divisions 02 to 49.

1.3 DESCRIPTION

- .1 Demonstrate scheduled operation and maintenance of equipment to Department Representative's personnel two (2) weeks prior to date of final inspection.
- .2 Department Representative will provide list of personnel to receive instructions, and will coordinate their attendance at agreed-upon times.

1.4 COMPONENT DEMONSTRATION

- .1 Manufacturer to provide authorized representative to demonstrate operation of equipment and systems.
- .2 Instruct Department Representative's personnel, and provide written report that demonstration and instructions have been completed.

1.5 SUBMITTALS

- .1 Submit schedule of time and date for demonstration of each item of equipment and each system two (2) weeks prior to designated dates, for Department Representative's approval.
- .2 Submit reports within one (1) week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .3 Give time and date of each demonstration, with list of persons present.

1.6 CONDITIONS FOR DEMONSTRATIONS

- .1 Testing, adjusting, and balancing have been performed in accordance with Section 01 91 13, and equipment and systems are fully operational.
- .2 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

Part 2 Products

2.1 NOT USED

- .1 Not used.

Part 3 Execution

3.1 PREPARATION

- .1 Verify that suitable conditions for demonstration and instructions are available.
- .2 Verify that designated personnel are present.
- .3 Prepare agendas and outlines.
- .4 Establish seminar organization.
- .5 Explain component design and operational philosophy and strategy.
- .6 Develop equipment presentations.
- .7 Present system demonstrations.
- .8 Accept and respond to seminar and demonstration questions with appropriate answers.

3.2 PREPARATION OF AGENDAS AND OUTLINES

- .1 Prepare agendas and outlines including the following:
 - .1 Equipment and systems to be included in seminar presentations.
 - .2 Name of companies and representatives presenting at seminars.
 - .3 Outline of each seminar's content.
 - .4 Time and date allocated to each system and item of equipment.
 - .5 Provide separate agenda for each system.

3.3 SEMINAR ORGANIZATION

- .1 Coordinate content and presentations for seminars.
- .2 Coordinate individual presentations and ensure representatives scheduled to present at seminars are in attendance.
- .3 Arrange for presentation leaders familiar with the design, operation, maintenance and troubleshooting of the equipment and systems. Where a single person is not familiar with all aspects of the equipment or system, arrange for specialists familiar with each aspect.
- .4 Coordinate proposed dates for seminars with Department Representative and select mutually agreeable dates.

3.4 EXPLANATION OF DESIGN STRATEGY

- .1 Explain design function of each system. Include following information:
 - .1 An overview of how system is intended to operate.

- .2 Description of design parameters, constraints and operational requirements.
- .3 Description of system operation strategies.
- .4 Information to help in identifying and troubleshooting system problems.

3.5 DEMONSTRATION AND INSTRUCTIONS

- .1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, logic, servicing, and maintenance of each item of equipment at scheduled times, at the equipment location.
- .2 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.
- .3 Instruct personnel on control and maintenance of sensory equipment and operational equipment associated with maintaining energy efficiency and longevity of service.
- .4 Review contents of manual in detail to explain all aspects of operation and maintenance.
- .5 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

- .1 General requirements relating to commissioning of project's components and systems, specifying general requirements of system functional performance testing, equipment, sub-systems, systems, and integrated systems.

.2 Related Sections:

- .1 Section 01 45 00 - Quality Control.

.3 References:

- .1 Appendix B - Commissioning Plan
- .2 CSA Z320-11-Building Commissioning
- .3 ASHRAE Guideline 1.1 - 2007

.4 Acronyms:

- .1 BMM - Building Management Manual
- .2 ESR - Equipment Start-Up and Acceptance Report
- .3 O&M - Operation and Maintenance
- .4 SFPTF - System Functional Performance Test Form
- .5 SVF - System Verification Form
- .6 TAB - Testing, Adjusting and Balancing
- .7 CCC - Contractor's Commissioning Coordinator
- .8 CPS - Commissioning Plan Schedule.

1.2 GENERAL

- .1 Commissioning is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Commissioning is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved.

- .2 Objectives:
 - .1 To bring mechanical and electrical systems from a state of static completion to a state of dynamic operation;
 - .2 To verify conformance to contract requirements;
 - .3 To verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria;
 - .4 To ensure that the completed facility meets design criteria and effectively train O&M staff; and
 - .5 To ensure appropriate documentation is compiled into the BMM.
- .3 The contractor shall assist in commissioning process, operating equipment and systems, troubleshooting and making adjustments as required.
 - .1 Systems to be operated at full and partial capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to interact with each other as intended in accordance with Contract Documents and design criteria.
 - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .4 Design Criteria:
 - .1 As per Departmental Representative's requirements or determined by designer.
 - .2 To meet Project functional and operational requirements.

1.3 COMMISSIONING OVERVIEW

- .1 Commissioning to be a line item of Contractor's cost breakdown.
- .2 Commissioning activities supplement field quality and testing procedures described in relevant technical sections.
- .3 Departmental Representative will issue Interim Acceptance Certificate when:
 - .1 Completed commissioning documentation , including integrated commissioning documentation has been received, reviewed for suitability and approved by the Departmental Representative;
 - .2 Equipment, components and systems have been commissioned; and
 - .3 O&M training has been completed.

1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during commissioning, correct deficiencies, re-verify equipment and components within the un-functional system, including related systems as deemed required by Departmental Representative, to ensure effective performance.
- .2 All associated trades shall be available for any retests.
- .3 The costs for corrective work, additional tests and inspections required to determine the acceptability and proper performance of such items to be borne by the Contractor. The above costs shall be in the form of progress payment reductions or hold-back assessments.

1.5 PRE-COMMISSIONING REVIEW

- .1 Before Construction:
 - .1 Review contract documents and confirm in writing to Departmental Representative for the following:
 - .1 Adequacy of provisions for commissioning; and
 - .2 Aspects of design and installation pertinent to success of commissioning.
 - .2 During Construction:
 - .1 Co-ordinate provision, location and installation of provisions for commissioning.
 - .3 Before Start of Commissioning:
 - .1 Have completed Commissioning Plan up-to-date;
 - .2 Ensure installation of related components, equipment, systems and sub-systems is complete;
 - .3 Fully understand commissioning requirements and procedures;
 - .4 Have commissioning documentation shelf-ready;
 - .5 Understand completely the design criteria and intent and special features;
 - .6 Submit complete start-up documentation to Departmental Representative;
 - .7 Have commissioning schedules up-to-date;
 - .8 Ensure systems have been cleaned thoroughly;

- .9 Complete TAB procedures on systems and submit TAB reports to Departmental Representative for review and approval;
- .10 Contractor shall supply commissioning procedures and expected outcomes for each pieces of equipment / system to be commissioned.

1.6 CONFLICTS

- .1 Report conflicts between requirements of this section and other sections to Departmental Representative before start-up and obtain clarification.
- .2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.7 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 Submittal Procedures.
- .2 Submit no later than 3 weeks after award of Contract:
 - .1 Name of Contractor's Commissioning Authority;
 - .2 Draft commissioning documentation; and
 - .3 Preliminary commissioning schedule.
- .3 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least 12 weeks prior to start of commissioning.
- .4 Submit proposed commissioning procedures to Departmental Representative where not specified and obtain written approval at least 12 weeks prior to start of commissioning.
- .5 Provide additional documentation relating to Commissioning process required by Departmental Representative.

1.8 COMMISSIONING DOCUMENTATION

- .1 Departmental Representative to review and approve commissioning documentation.
- .2 Provide completed and approved commissioning documentation to Departmental Representative.

1.9 COMMISSIONING SCHEDULE

- .1 The General Contractor shall prepare and coordinate the CPS with the construction schedule, and the commissioning schedule prepared and submitted by the contractor.
- .2 The CPS will be updated every month. Copies of this schedule and updates will be distributed to:
 - .1 CA – Commissioning Authority
 - .2 PM – Project Manager
 - .3 GC – General Contractor
 - .4 Any additional personnel indicated by the departmental representative.
- .3 Contractor to provide detailed commissioning schedule as part of the construction schedule in accordance with Section 01 32 00 - Construction Progress Documentation.
- .4 Provide adequate time for commissioning activities prescribed in technical sections and commissioning sections including:
 - .1 Approval of commissioning reports;
 - .2 Verification of reported results;
 - .3 Repairs, re-testing, re-commissioning, re-verification; and
 - .4 Training.

1.10 COMMISSIONING MEETINGS

- .1 Purpose: to resolve issues, monitor progress, identify deficiencies relating to commissioning.
- .2 Meetings shall be regularly scheduled by the Departmental Representative (generally every two weeks) in order to plan, discuss, and review commissioning activities. Continue commissioning meetings on regular basis until commissioning deliverables have been addressed.
- .3 Meetings shall take place until work has been completed.
- .4 The construction schedule, commissioning plan schedule, and the commissioning plan shall be reviewed and updated as required. Upcoming tests and equipment start-ups shall be reviewed and completed test results will be evaluated.

- .5 The Departmental Representative will take minutes of meetings and distribute copies to all team members within one week of a meeting.
- .6 At 60 % construction completion stage Departmental Representative to call a separate commissioning scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for commissioning. Issues at the meeting to include:
 - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems; and
 - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .7 Meeting will be chaired by Departmental Representative who will record and distribute minutes.
- .8 Ensure subcontractors and relevant manufacturer representatives are present at 60 % and subsequent commissioning meetings and as required.

1.11 STARTING AND TESTING

- .1 Contractor assumes liabilities and costs for inspections including disassembly and re-assembly after approval, starting, testing and adjusting and supply of testing equipment.

1.12 WITNESSING OF STARTING AND TESTING

- .1 Provide 5 days notice prior to commencement.
- .2 Departmental Representative to witness start-up and testing.
- .3 Contractor's Commissioning Authority to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.13 MANUFACTURER'S INVOLVEMENT

- .1 Factory testing:
- .2 Equipment manufacturer to:
 - .1 Coordinate time and location of testing;

- .2 Provide testing documentation for approval by Departmental Representative;
 - .3 Arrange for Departmental Representative to witness tests; and
 - .4 Obtain written approval of test results and documentation from Departmental Representative before delivery to site.
- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Departmental Representative.
 - .3 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
 - .4 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
 - .5 Integrity of warranties:
 - .1 Use manufacturers' trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
 - .2 Verify with manufacturer that testing as specified will not void warranties.
 - .6 Qualifications of manufacturer's personnel:
 - .1 Experienced in design, installation and operation of equipment and systems;
 - .2 Ability to interpret test results accurately; and
 - .3 To report results in clear, concise, logical manner.

1.14 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and commissioning.
- .2 Conduct start-up and testing in following distinct phases:
- .3 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved shop drawings and completion of SVF; and
 - .2 Visual inspection of quality of installation;
 - .3 Equipment Start-Up: follow accepted start-up procedures.
 - .4 Operational testing: document equipment performance.
 - .5 System Functional Performance Testing: include repetition of tests after correcting deficiencies.

- .6 Post-substantial performance verification: to include fine-tuning.
- .4 Correct deficiencies and obtain approval from Departmental Representative after distinct phases have been completed and before commencing next phase.
- .5 Document required tests on approved SFPTF forms.
- .6 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Departmental Representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
 - .1 Minor equipment/systems: implement corrective measures approved by Departmental Representative.
 - .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Departmental Representative.
 - .3 If evaluation report concludes that major damage has occurred, Departmental Representative shall reject equipment.
 - .1 Rejected equipment to be removed from site and replaced with new.
 - .2 Subject new equipment or systems to specified start-up procedures.

1.15 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to Departmental Representative for approval before commencement of commissioning.
- .2 Start-up documentation to include:
 - .1 Factory and on-site test certificates for specified equipment;
 - .2 Pre-start-up inspection reports;
 - .3 Signed installation/start-up check lists;
 - .4 Start-up reports; and
 - .5 Step-by-step description of complete start-up procedures, to permit Departmental Representative to repeat start-up at any time.

1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 With assistance of manufacturer develop written maintenance program and submit to Departmental Representative for approval before implementation.
- .3 Operate and maintain systems, as per manufacturer's recommendations, for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems as per manufacturer's recommendation until issuance of certificate of interim acceptance.

1.17 TEST RESULTS

- .1 If start-up, testing and/or SFPTF produce unacceptable results, repair, replace or repeat specified starting and/or SFPTF procedures until acceptable results are achieved.
- .2 Provide manpower and materials and assume costs for re-commissioning.

1.18 START OF COMMISSIONING

- .1 Notify Departmental Representative at least 28 days prior to start of commissioning.
- .2 Commence commissioning after elements of building affecting start-up and performance verification of systems have been completed.

1.19 INSTRUMENTS / EQUIPMENT

- .1 Submit to Departmental Representative for review and approval:
 - .1 Complete list of instruments proposed to be used; and
 - .2 Listed data including serial number, current calibration certificate, calibration date, calibration expiry date and calibration accuracy.
- .2 Provide all equipment and supplies as required.

1.20 AUTHORITIES HAVING JURISDICTION

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of Authority Having Jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of Authority Having Jurisdiction.
- .3 Provide copies to Departmental Representative, within 5 days of test and with commissioning report.

1.21 SEASONAL COMMISSIONING

- .1 After all system commissioning has been accepted by the Departmental Representative seasonal commissioning shall be initiated. All trades and manufacturer's that are required to perform these tests must be present.

1.22 EXTENT OF VERIFICATION

- .1 Provide manpower and instrumentation to verify up to 100 % of reported results.
- .2 Number and location to be at discretion of the Departmental Representative.
- .3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment and instrumentation.
- .4 Review and repeat commissioning of systems if inconsistencies are found in more than 20 % of reported results.
- .5 Perform additional commissioning until results are acceptable to Departmental Representative.

1.23 REPEAT VERIFICATIONS

- .1 Assume costs incurred by Departmental Representative for third and subsequent verifications where:
 - .1 Verification of reported results fail to receive approval.
 - .2 Repetition of second verification again fails to receive approval; and
 - .3 Departmental Representative deems Contractor's request for second verification was premature.

1.24 CHECKS AND ADJUSTMENTS

- .1 Make adjustments and changes which become apparent as commissioning proceeds.
- .2 Perform static and operational checks as applicable and as required.

1.25 DEFICIENCIES, FAULTS, DEFECTS

- .1 Correct deficiencies found during start-up and commissioning to satisfaction of Departmental Representative.
- .2 Report problems, faults or defects affecting commissioning to Departmental Representative in writing. Stop commissioning until problems are rectified. Proceed with written approval from Departmental Representative.

1.26 COMPLETION OF COMMISSIONING

- .1 Upon completion of commissioning leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in commissioning specifications, complete commissioning prior to issuance of Interim Certificate of Completion.
- .3 Commissioning to be considered complete when contract commissioning deliverables have been submitted and accepted by Departmental Representative.

1.27 ACTIVITIES UPON COMPLETION OF COMMISSIONING

- .1 When changes are made to baseline components or system settings established during commissioning process, provide updated commissioning form for affected items.

1.28 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS 1.33 OCCUPANCY

- .1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.
- .2 Cooperate fully with Departmental Representative during stages of acceptance and occupancy of facility.

1.29 INSTALLED INSTRUMENTATION

- .1 Use instruments installed under contract for TAB and System Functional Performance Testing if:
 - .1 Accuracy complies with these specifications; and
 - .2 Calibration certificates have been deposited with Departmental Representative.
- .2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.30 SYSTEM FUNCTIONAL PERFORMANCE TESTING TOLERANCES

- .1 Application tolerances:
 - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria, except for special areas, to be within +/- 5 % of specified values.
- .2 Instrument accuracy tolerances to be of higher order of magnitude than equipment or system being tested
- .3 Measurement tolerances during verification:

- .1 Unless otherwise specified actual values to be within +/- 2 % of recorded values.

1.31 DEPARTMENTAL REPRESENTATIVE'S PERFORMANCE TESTING

- .1 Performance testing of equipment or systems by Departmental Representative will not relieve Contractor from compliance with specified start-up and testing procedures.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Division 01 - General Requirements.
- .2 Section 03 20 00 - Concrete Reinforcing.
- .3 Section 03 30 00 - Cast-in-Place Concrete.
- .4 Section 03 35 00 - Concrete Finishing.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction.
 - .2 CAN/CSA A23.3-04(R2010), Design of Concrete Structures.
 - .3 CSA-O86-09, Engineering Design in Wood.
 - .4 CSA O121-08(R2013), Douglas Fir
 - .5 CSA O151-09, Canadian Softwood Plywood.
 - .6 CSA O153-13, Poplar Plywood.
 - .7 CSA O325-07 (R2012), Construction Sheathing.
 - .8 CSA S269.1-1975(R2003), Falsework for Construction Purposes.
 - .9 CAN/CSA-S269.3-M92 (R2013) Concrete Formwork.
- .2 Council of Forest Industries of British Columbia (COFI)
 - .1 COFI Exterior Plywood for Concrete Formwork.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Responsibility:

- .1 Contractor to design for method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, ties, liners, and locations of temporary embedded parts. Comply with CAN/CSA-S269.3 for formwork drawings.
 - .2 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms upon request from Departmental Representative.
- .2 Shop Drawings:
- .1 Submit shop drawings for formwork and falsework in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangements of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1, for falsework drawings. Comply with CAN/CSA-S269.3 for formwork drawings.
 - .3 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.
 - .4 Indicate sequence of erection and removal of formwork/falsework as directed by Departmental Representative.
 - .5 Each shop drawing submission shall bear stamp and signature of qualified Professional Engineer registered or licensed in the Province of Nova Scotia.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .4 Use sealers, form release and stripping agents that are non-toxic, biodegradable and have zero or low VOC's.

1.5 DELIVERY STORAGE AND HANDLING

- .1 Deliver, handle and store formwork materials to prevent weathering, warping of damage detrimental to the strength of the materials or to the surface to be formed.
- .2 Ensure that formwork surfaces which will be in contact with concrete are not contaminated by foreign matter. handle and erect the fabricated formwork so as to prevent damage.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Formwork materials:
 - .1 For concrete without special architectural features, use wood and wood product formwork materials to CAN/CSA-A23.1/A23.2 and CSA O121.
 - .2 For concrete to remain exposed to view, use formwork materials to CSA A23.1/A23.2.
- .2 Falsework materials: to CSA S269.1
- .3 Form ties:
 - .1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm dia. in concrete surface. Holes are to be filled with non-shrink grout.
 - .2 Patch all form tie holes and finish surface to remove all evidence of tie holes and/or patching.
 - .3 Adjustable in length to permit tightening and alignment of forms.
 - .4 Provide snap off ties suitable for water retaining structures complete with water flange and 50 mm break back.
- .4 Form liner:
 - .1 Plywood: Douglas Fir to CSA O121 or Canadian Softwood Plywood to CSA O151.
 - .2 Waferboard: to CAN/CSA O325.

- .5 Form release agent: non-toxic, biodegradable, low VOC, chemically active release agents containing compounds that react with free lime present in concrete to provide water insoluble soaps, preventing concrete from sticking to forms.
- .6 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 15 to 24 mm²/S at 40°C, flashpoint minimum 150°C, open cup.
- .7 Sealant: to Section 07 92 00 – Joint Sealants.

PART 3 EXECUTION

3.1 FABRICATION AND ERECTION

- .1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings. Any pilasters are to be formed and poured monolithically with walls. Review all drawings and check dimensions prior to construction for proper fit and report any discrepancies before proceeding with the work.
- .2 Obtain Departmental Representative's approval for use of earth forms.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Obtain Departmental Representative's approval before framing openings not indicated on drawings.
- .5 Assemble formwork so that concrete is not damaged during its removal.
- .6 Do not place shores and mud sills on frozen ground.
- .7 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .8 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CAN/CSA-A23.1 and A23.2.
- .9 Align form joints and make watertight. Keep form joints to minimum.
- .10 Locate horizontal form joints for walls and pilasters below top of finished grade. Minimize total length of form joints above grade.
- .11 Use 25 mm chamfer strips on external corners and 25 mm fillets at interior corners, joints, unless specified otherwise.

- .12 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .13 Prior to placing concrete, the elevations of forms shall be checked to verify drainage slopes.
- .14 Provide 48 hours notice to Departmental Representative for inspection prior to concrete placement.
- .15 Build in anchors, anchor bolts, miscellaneous frames, flashing reglets, weather bars, holes, sleeves, and other inserts required to accommodate Work specified in other sections.
 - .1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied surfaces, including painting.
 - .2 Embed no wood in concrete for purposes of anchorage.
- .16 Secure all anchors and dowels in place using ties, chairs, templates, and forms as required prior to placing concrete.
- .17 Supply and install all supports and ties required, to secure all embedded parts, as required.
- .18 Clean formwork as erection proceeds, to remove foreign matter. Remove cuttings, shavings and debris from within forms. Flush completely with water to remove remaining foreign matters. Ensure that water and debris drain to exterior through clean-out ports. Clean to CSA-A23.1/A23.2.
- .19 During cold weather, remove ice and snow from within forms, do not use de-icing salts. Do not use water to clean out completed forms, unless formwork and concrete construction proceed within a heated enclosure.
- .20 Patch all form tie holes and finish surface to remove all evidence of tie holes and/or patching.
- .21 Construction Joints:
 - .1 Form construction joints where required and as approved.
 - .2 Build waterstops into forms, supported against displacement by pouring of concrete. Do not install waterstops between footings and walls, or between slabs on fill and walls except where indicated on drawings.
 - .3 Use preformed waterstop corners and intersections where they are available to suit conditions.
 - .4 Join waterstops to preformed corners and intersections, and between lengths with butted and welded connections in accordance with manufacturer's recommendations.

3.2 REMOVAL AND RESHORING

- .1 Notify Departmental Representative prior to form removal.
- .2 Form removal times are dependent on proper curing in accordance with CAN/CSA - A23.1, CSA S269.1 and CAN/CSA-S269.3. Contractor shall provide written evidence of concrete strength to the Departmental Representative 24 hours prior to form removal to show that suitable strength has been achieved. Contractor shall pay for the concrete cylinder strength tests to demonstrate concrete strength prior to form removal.
- .3 Remove formwork progressively and in accordance with the reference code requirements, and so that no shock loads or imbalanced loads are imposed on the structure.
- .4 Leave formwork in place for following minimum periods of time after placing concrete.
 - .1 3 Days for footings.
 - .2 3 Days for foundation walls and pilasters.
 - .3 28 Days for beam soffits and suspended slabs or 7 days when replaced immediately with adequate shoring.
 - .4 Provide temporary material supports for cantilever walls until lateral supports are provided by permanent structural framing.
- .5 Re-use formwork and falsework subject to requirements of CAN/CSA-A23.1.
- .6 Loosen forms carefully. do not wedge pry bars, hammers or tools against concrete surfaces.
- .7 Remove forms not directly supporting the weight of concrete as soon as stripping operations will not damage concrete.
- .8 Provide all necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.
- .9 Space reshoring in each principal direction at not more than 3,000 mm apart.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Division 01 - General Requirements.
- .2 Section 03 10 00 - Concrete Forming and Accessories.
- .3 Section 03 30 00 - Cast-in-Place Concrete.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction.
 - .2 CAN/CSA-A23.3-04(R2010), Design of Concrete.
 - .3 CAN/CSA-G30.18-09, Billet-Steel Bars for Concrete Reinforcement.
 - .4 CSA-G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .5 CSA W186-M1990(R2012) - Welding of Reinforcing Bars in Reinforced Concrete Construction.
 - .6 CAN/CSA W47.1-09 - Certification of Companies For Fusion Welding.
- .2 Reinforcing Steel Institute of Canada(RSIC)
 - .1 RSIC Reinforcing Steel Manual of Standard Capital Practice.
- .3 American Concrete Institute (ACI)
 - .1 SP-66-04,ACI Detailing Manual.
- .4 ASTM International
 - .1 ASTM A1064/A1064M-13, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Shop Drawings:
 - .1 Submit reinforcing steel shop drawings for review by the Departmental Representative that are sealed and signed by a licensed Professional Engineer in the Province of Nova Scotia. Contractor to approve and sign drawings prior to submission indicating co-ordination.
 - .2 Indicate on shop drawings, bar bending details, lists, quantities of reinforcement, splice lengths, sizes, spacings, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings. Indicate sizes, spacings and locations of chairs, spacers and hangers.
 - .3 Prepare reinforcement drawings in accordance with RSIC Reinforcing Steel Manual of Standard Practice and to ACI SP-66.
- .2 Detail splice lengths to CAN/CSA-A23.3 as follows:
 - .1 All splices to be tension lap splices, Class "B".
 - .2 No more than 50% of the reinforcing to be spliced at any given location.
- .3 All corners and intersections to have corner bars, same size and spacing as main bars. Provide tension lap with main bars.
- .4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Departmental Representative before placing concrete.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.

1.5 QUALITY

- .1 Submit in accordance with Section 01 45 00 - Quality Control and as described in PART 2 - Source Quality Control.

- .1 Mill Test Report: Provide Departmental Representative with certified copy of mill test report of reinforcing steel, minimum 4 weeks prior to beginning reinforcing work.
- .2 Submit in writing to Departmental Representative proposed source of reinforcement material to be supplied.

1.6 DELIVERY, STORAGE AND

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturers written instructions.
- .2 Storage and Handling Requirements:
 - .1 Store materials in a dry location and in accordance with manufacturers recommendation in a clean, dry and well ventilated area.
 - .2 Store reinforcing steel to prevent deterioration, contamination, or disfigurement.
 - .3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Departmental Representative.
- .2 Reinforcing steel:
 - .1 Billet steel, grade 400, deformed bars to CAN/CSA-G30.18, unless indicated otherwise.
 - .2 Weldable low alloy steel deformed bars to CAN/CSA-G30.18.
- .3 Cold-drawn annealed steel wire ties; minimum 1.5 mm diameter to ASTM A1064/A1064M.
- .4 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2 and adequate for strength and support of reinforcing during construction conditions, all of which to be non-staining.
- .5 Mechanical splices: subject to approval of Departmental Representative.

- .6 Plain round bars: to CAN/CSA-G40.21.
- .7 Welded Wire Reinforcement (WWR): to ASTM A1064/A1064M.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CAN/CSA-A23.1, ACI SP-66, and RSIC Reinforcing Steel Manual of Standard Practice. Shop fabricate and bend all reinforcing steel.
- .2 Match dowels from footings to vertical reinforcing in wall or pedestal above.
- .3 Fabricate to the following tolerances:
 - .1 Sheared length ± 25 mm.
 - .2 Stirrups, items and spirals ± 10 mm.
 - .3 Other bends ± 25 mm.
- .4 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.
- .5 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.
- .6 Have welding performed by workers qualified under CAN/CSA W47.1, Division 1 or 2.
- .7 Welding of reinforcing steel shall receive prior approval of the Departmental Representative.
- .8 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

- .1 Provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to commencing reinforcing work. Mill certificate shall be in accordance with CAN/CSA G30.18.
- .2 Inform Departmental Representative of proposed source of material to be supplied.

2.4 CLEANING

- .1 Clean reinforcing to CAN/CSA-A23.1/A23.2. All reinforcing bars are to be free of scale rust and contamination at time of placing in forms.

PART 3 EXECUTION

3.1 FIELD BENDING

- .1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- .3 Replace bars that develop cracks or splits.

3.2 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CAN/CSA-A23.1/A23.2.
- .2 Use plain round bars as slip dowels in concrete. Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint. When paint is dry, apply a thick even film of mineral lubricating grease. Secure in place as required.
- .3 Provide all chairs, braces, lateral support, headers, ties, etc. to secure reinforcing in place during construction.
- .4 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.
- .5 Ensure cover to reinforcement is maintained during concrete pour.
- .6 Under no circumstances will concrete trucks be permitted to travel over the reinforcing during concrete placing operations.

- .7 After reinforcing is placed and prior to closing of forms, notify the Departmental Representative for inspection of the Work.
- .8 Reinforcement shall be adequately supported by metal chairs, spacers or hangers and secured against displacement within the tolerances permitted and in accordance with ACI SP-66 and the RSIC Reinforcing Steel Manual of Standard Practice.

3.3 CLEANING

- .1 Final Cleaning: upon completion remove surplus material, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Division 01 - General Requirements.
- .2 Section 03 10 00 - Concrete Forming and Accessories.
- .3 Section 03 20 00 - Concrete Reinforcing.
- .4 Section 03 35 00 - Concrete Finishing.
- .5 Section 05 50 00 - Metal Fabrications.
- .6 Section 07 92 00 - Joint Sealants.
- .7 All Mechanical Sections.
- .8 All Electrical Sections.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM C 260/C 260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C 309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .3 ASTM C 494/C 494M-13, Standard Specification for Chemical Admixtures for Concrete.
 - .4 ASTM C 1017/C 1017M-13, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
 - .5 ASTM D 412-06a(R2013), Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
 - .6 ASTM D 624-00(2007), Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
 - .7 ASTM D 1751-04(R2013), Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

- .8 ASTM D 1752-04(R2013), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .9 ASTM E96/E96M-13, Standard Test Methods for Water Vapor Transmission of Materials.
- .10 ASTM F1249-13, Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.
- .2 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction.
 - .2 CSA A3000-13 Cementitious Materials Compendium (includes A3001, A3002, A3003, A3004 and A3005).
- .3 American Concrete Institute (ACI)
 - .1 ACI 117M-10, Specifications for Tolerances for Concrete Construction and Materials and Commentary.
- .4 Canadian Standards Board (CGSB)
 - .1 CAN/CGSB-37.2-M88, Emulsified Asphalt, Mineral Colloid-Type, Unfilled, for dampproofing and Waterproofing and for Roof Coatings.
 - .2 CAN/CGSB-51.34-M86(R1988, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

1.3 SAMPLES

- .1 At least 4 weeks prior to commencing work, inform Departmental Representative of proposed source of aggregates and provide access for sampling.

1.4 CERTIFICATES

- .1 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CAN/CSA-A23.1.
- .2 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CAN/CSA-A23.1.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings:
 - .1 Convene pre-installation meeting minimum one week prior to beginning concrete work. Ensure key personnel attend.
 - .2 Verify project requirements.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Minimum 4 weeks prior to starting concrete work, submit concrete mix design showing:
 - .1 Maximum aggregate size.
 - .2 Concrete strength.
 - .3 Cement type.
 - .4 Content of cement, SCM, water, coarse aggregate, fine aggregate, additives, and air.
 - .5 Air content (%).
 - .6 Exposure classification.
 - .7 Slump at time of discharge.
 - .8 Cement content (kg/m^3).
 - .9 Water-to-cement ratio.
 - .10 Proposed admixtures.
- .2 Submit testing results for review by Departmental Representative and do not proceed without written approval from Departmental Representative when deviations from mix design or parameters are found.
- .3 Provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 – FIELD QUALITY CONTROL.
- .4 Submit for review by Departmental Representative deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of work and discharged after batching.
- .5 Contractor to provide letter(s) confirming that the various cast-in-place concrete mixes and all contractor/ventor supplied additives are compatible, including but

not limited to performance enhancers, cementing materials, finishing products, curing and/or sealing agents, joint filling and joint sealant products, etc.

1.7 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Submit to Departmental Representative, minimum 4 weeks prior to starting concrete work, valid and recognizing certificate from plant delivering concrete.
 - .1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete will meet specified requirements.
- .3 Minimum 4 weeks prior to starting concrete work, submit proposed quality control procedures for review by Departmental Representative on following items.
 - .1 Falsework erection.
 - .2 Hot weather concrete.
 - .3 Cold weather concrete.
 - .4 Curing.
 - .5 Finishes.
 - .6 Formwork removal.
 - .7 Joints.
 - .8 Securing of dowels and anchor bolts.
- .4 Quality Control Plan: provide written report to Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 – PRODUCTS.
- .5 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 23 – Health and Safety.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Concrete hauling time: maximum allowable time for concrete to be delivered to site of Work and discharged not to exceed 120 minutes after batching.
- .2 Concrete delivery: ensure continuous concrete delivery from plant meetings CSA A23.1/A23.2.

- .3 Divert unused concrete materials from landfill to local facility approved by Departmental Representative.
- .4 Provide an appropriate area on the job site where concrete trucks can be safely washed.
- .5 Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site as approved by the Departmental Representative.
- .6 Unused admixtures and additive materials must not be disposed of into sewer systems, into lakes, streams, onto ground or in other location where it will pose health or environmental hazard.
- .7 Prevent admixtures and additive materials from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with inert, noncombustible material and remove for disposal. Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

1.9 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Use trigger operated spray nozzles for water hoses.
- .3 Designate a cleaning area for tools to limit water use and runoff.
- .4 Carefully coordinate the specified concrete work with weather conditions.
- .5 Ensure emptied containers are sealed and stored safely for disposal away from children.
- .6 Prevent plasticizers, water-reducing agents and air-entraining agents from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with an inert, noncombustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.
- .7 Choose least harmful, appropriate cleaning method that will perform adequately.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Portland cement: Type GU to CAN/CSA-A23.1/A23.2 and CSA-A3001.
- .2 Supplementary cementing materials (SCM): Type F fly ash or ground granulated blast furnace slag replacement to CAN/CSA A3001. Maximum SCM replacement of Portland cement to be 15%. Only one SCM is permitted.
- .3 Water: to CAN/CSA-A23.1/A23.2.
- .4 Aggregates: to CAN/CSA-A23.1/A23.2 coarse aggregates to be normal density.
- .5 Air entraining admixture: to ASTM C260. Add air entraining agent to all mixes as indicated.
- .6 Chemical admixtures: to ASTM C494 or ASTM C1017. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .7 Concrete retarders: to ASTM C 494. Do not allow moisture of any kind to come in contact with the retarder film.
- .8 Concrete shall have a unit weight of 2350 kg/m³.
- .9 All below ground concrete for thrust blocks to be 25 MPa sulfate resistant.
- .10 Joint Sealant: to Section 07 92 00 – Joint Sealants.
 - .1 Primer to be compatible with Sealant.
- .11 Premoulded joint fillers: Acceptable products include:
 - .1 Bituminous impregnated fiberboard: to ASTM D 1751.
- .12 Curing compound: to Section 03 35 00 – Concrete Finishing.
- .13 Concrete floor sealer: to Section 03 35 00 – Concrete Finishing.
- .14 Saw cut joint filler: two component semi-rigid epoxy-only filler with a shore A hardness at 28 days of greater than or equal to 90, per ASTM D2240.
- .15 Ribbed waterstops: extruded PVC of sizes indicated with shop welded corner and intersecting pieces with legs not less than 500 mm long.
 - .1 Tensile strength: to ASTM D 412, Die "C" method, minimum 11.4 MPa.

- .2 Elongation: to ASTM D 412, Die "C" method, minimum 275%.
- .3 Tear resistance: to ASTM D 624, Die "B" method, minimum 48 kN/m.
- .16 Shrinkage Compensating Grout: pre-mixed compound consisting of non-metallic aggregate, Portland Cement, water-reducing and plasticizing agents to CAN/CSA A23.1/A23.2.
 - .1 Compressive strength: 50 MPa at 28 days.
 - .2 Net shrinkage at 28 days: maximum 2%.
 - .3 Fluid: to ASTM C827. Time of efflux through flow cone to ASTM C939: under 30 seconds.
 - .4 Flowable: to ASTM C827. Flow Table, 5 drops in 3 seconds, (ASTM C109/C109M), 125%-145%.
 - .5 Plastic: to ASTM C827 Flow Table, 5 drops in 3 seconds, (ASTM C109/C109M, 100%-125%.
- .17 Non premixed dry pack grout: composite of non metallic aggregate Portland Cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 50 MPa at 28 days.
- .18 Dampproof membrane:
 - .1 For below slab: refer to 07 26 23 - Sub Grade Membrane - Gas Barrier.
 - .2 For foundation walls: refer to 07 13 00 - Sheet Waterproofing.
- .19 Weep hole tubes: plastic, unless indicated otherwise.
- .20 Cementitious crystalline concrete waterproofing coating: acceptable products include:
 - .1 XYPEX Chemical Corporation: XYPEX Concentrate.
 - .2 Tremco Commercial Sealants & Waterproofing: Permaquick Crystalline Waterproofing.
 - .3 Kryton International Inc.: Kryton T1 & T2 Waterproofing System.
- .21 Epoxy Adhesive Anchor Bolts: acceptable products include:
 - .1 Hilti Inc.: HIT-HY 200 Adhesive Anchoring System.
 - .2 Powers Fasteners: PE1000+ Epoxy Adhesive Anchoring System.
 - .3 Simpson Strong-Tie: SET-XP Anchoring Adhesive.
- .22 Anchor Rods: to ASTM F1554, Grade 36, unless noted otherwise.

2.2

MIXES

- .1 Proportion normal density concrete in accordance with CAN/CSA-A23.1/A23.2, Alternative 1 - Performance.
- .2 Co-ordinate construction methods to suit concrete mix proportions and parameters.
- .3 Identify and immediately report to Departmental Representative when concrete mix design and parameters pose anticipated problems or deficiencies related to construction.
- .4 All concrete shall conform to the following requirements unless noted otherwise herein.
 - .1 Mix 1 for mud slabs, concrete fill for excavation under footing and thrust blocks.
 - .1 Type GU Portland cement.
 - .2 Minimum compressive strength at 28 days: 25 MPa
 - .3 Exposure classification: F-2
 - .4 Nominal maximum size of coarse aggregate: 10 mm.
 - .5 Slump at time and point of discharge: as per CAN/CSA A23.1, not to exceed 80 mm.
 - .6 Air content: 6 to 9%.
 - .7 Chemical Admixtures: in accordance with ASTM C494 or ASTM C1017.
 - .2 Mix 2 for footings, foundation walls and pilasters.
 - .1 Type GU Portland cement.
 - .2 Minimum compressive strength at 28 days: 30 MPa.
 - .3 Exposure classification: F-1.
 - .4 Nominal maximum size of coarse aggregate: 20 mm.
 - .5 Slump at time and point of discharge: to CAN/CSA-A23.1, not to exceed 80 mm.
 - .6 Air content: 5 to 8%.
 - .7 Chemical admixtures: in accordance with ASTM C494 or ASTM C1017.
 - .3 Mix 3 for slab on grade, suspended slabs and interior housekeeping pads.
 - .1 Type GU Portland Cement.
 - .2 Minimum Compressive Strength at 28 Days: 30 MPa.
 - .3 Exposure Classification: F-1.

- .4 Nominal maximum size of course aggregate: 20 mm.
 - .5 Slump at time and point of discharge: to CAN/CSA-A23.1, not to exceed 80 mm.
 - .6 Air content: 5 to 8%.
 - .7 Chemical admixtures: in accordance with ASTM C494 or ASTM C1017.
- .4 Mix 4 for exterior sidewalks, ramps and pads.
- .1 Type GU Portland Cement.
 - .2 Minimum Compressive Strength at 28 Days: 35 MPa.
 - .3 Exposure Classification: C-1.
 - .4 Nominal maximum size of course aggregate: 20 m.
 - .5 Slump at time and point of discharge: to CAN/CSA-A23.1, not to exceed 80 mm.
 - .6 Air content: 5 to 8%.
 - .7 Chemical admixtures: in accordance with ASTM C494 or ASTM C1017.
- .5 Slump values are before addition of plasticizer. Add plasticizer as approved by Departmental Representative to achieve workability. Plasticizer to be supplied by mix plant.
- .6 In sufficient time before placement, submit the concrete mix design to the Departmental Representative for approval, in accordance with Section 01 33 00 - Submittal Procedures. No concrete shall be placed before the design is approved.
- .7 Obtain the Departmental Representative's approval before using chemical admixtures other than those specified.
- .8 Use of Calcium Chloride is not permitted.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Obtain Departmental Representative's approval before placing concrete. Provide 24 hours minimum notice prior to placing of concrete.
- .2 Place concrete reinforcing in accordance with Section 03 20 00 – Concrete Reinforcing.
- .3 Place, consolidate, finish, cure and protect concrete to CAN/CSA A23.1 except where specified otherwise.
- .4 Pumping of concrete is permitted only after approval of equipment and mix.
- .5 Secure in position reinforcing steel, embedded parts, dowels, inserts, etc. prior to placing concrete and ensure these are not disturbed during concrete placement in accordance with CAN/CSA A23.1.
- .6 Do not place sidewalk, ramp and pad concrete until all buried services have been installed and tested. Do not place sidewalks, ramps and pads until fill has been placed to the specified requirements.
- .7 Secure in position anchor bolts and rods during placement of concrete. Place anchor bolts with templates.
- .8 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .10 Do not place load upon new concrete until authorized by Departmental Representative.
- .11 Ensure that reinforcement and formwork are thoroughly clean before placing.
- .12 Place concrete in dry conditions.
- .13 During concreting operations:
 - .1 Development of cold joints not allowed.
 - .2 Ensure concrete delivery and handling facilities placing with minimum of rehandling, and without damage to existing structure or work.

- .14 Unless noted otherwise, place footings on undisturbed soil or engineered fill with minimum bearing capacity of 150 kPa (SLS) and 225 kPa (ULS), and meeting the specified requirements and as indicated in the Geotech Report. Geotechnical Engineer shall confirm bearing capacity in writing prior to the placement of concrete.
- .15 Ensure that foundation bearing materials are free from water and frost. Remove previously frozen bearing materials.
- .16 Keep excavation dry while placing concrete.
- .17 All exterior footings shall be founded at least 1.5 m below finished exterior grade, unless noted otherwise. Coordinate footing bearing with minimum frost depth, as indicated in Geotechnical Report.
- .18 Maintain adequate frost protection to all soils under footings for entire duration of work.
- .19 Protect previous work from staining.
- .20 Clean and remove stains prior to application for concrete finishes.
- .21 Bond fresh concrete to hardened concrete to CAN/CSA A23.1.
- .22 Do not permit vertical free fall of concrete mix to exceed 1500 mm.
- .23 Concrete trucks or any other vehicles are not permitted to drive on reinforcing mats.

3.2 INSTALLATION/APPLICATION

- .1 Do cast-in-place concrete work in accordance with CAN/CSA-A23.1/A23.2.
- .2 Sleeves and inserts.
 - .1 No sleeves, ducts, pipes or other openings shall pass through walls, pilasters, footings or beams except where indicated or approved by Departmental Representative.
 - .2 Where approved by Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 x 100 mm not indicated, must be approved by Departmental Representative.
 - .3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Departmental Representative before placing of concrete.

- .4 Check locations and sizes of sleeves and openings shown on drawings.
- .5 Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.
- .3 Drainage holes and weep holes:
 - .1 Form weepholes and drainage holes in accordance with Section 03 10 00 – Concrete Forming and Accessories. If wood forms are used, remove after concrete has set.
 - .2 Install weep hole tubes and drains as indicated.
- .4 Construction joints.
 - .1 Construction joint locations shall be approved by the Departmental Representative wherever they are not specifically designated on the drawings.
 - .2 Construction and isolation joints for sidewalks, ramps and pads shall be located and constructed as designated on drawings.
- .5 Saw cut control joints.
 - .1 Saw cut by soft-cut method as early as practicable or alternatively use the wet method, no sooner than twelve (12) hours and no later than twenty-four (24) hours after concrete placement. Ensure that reinforcement and work of other sections are located below cutting line.
 - .2 Chalk used for chalk-lining sawcuts shall not be red, blue or any colour with a dye that would stain the floor. Use white or light grey chalk only.
- .6 Joint fillers.
 - .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Departmental Representative. When more than one piece is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
 - .2 Locate and form isolation, construction, expansion joints as indicated. Install joint filler.
 - .3 Use joint filler to separate sidewalks, ramps and pads from vertical surfaces and extend joint filler from bottom of slab to within 12 mm of finished slab surface unless indicated otherwise. Fill top 12 mm with joint sealant as specified.
 - .4 Saw cut joint filler. All control and construction joints in sidewalks, ramps and pads: joint filler as specified in PART 2 - PRODUCTS. Wait as long as possible after placing slab to fill saw cut joints prior to occupancy. clean all dust and debris from the saw cuts and immediate area. Over fill saw cuts with the specified filler. Once the filler has hardened, cut joint flush with slab surface.

- .7 Waterstops (where indicated).
 - .1 Install waterstops to provide continuous water seal. Do not distort or pierce waterstop in such a way as to hamper performance. Do not displace reinforcement when installing waterstops. Use equipment to manufacturer's requirements to field splice waterstops. Tie waterstops rigidly in place.
 - .2 Use only straight heat sealed butt joints in field. Use factory welded corners and intersections unless otherwise approved by Departmental Representative.
- .8 Dampproof membrane:
 - .1 Refer to 07 26 23 - Sub Grade Membrane - Gas Barrier for under slab requirements and 07 13 00 - Sheet Waterproofing for foundation wall installation requirements.
 - .2 Seal punctures in dampproof membrane before placing concrete.
 - .3 Use patching material at least 150 mm larger than puncture and seal.
- .9 Anchor bolts and anchor rods.
 - .1 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.
- .10 Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100 % contact over grouted area.
- .11 Concrete shall not be placed on or against any surface (including rebar) that is at a temperature below 5°C.
- .12 Concrete at time of deposit shall be between 10°C and 30°C.
- .13 Excessive honeycomb or embedded debris in any concrete shall deem it defective. Remove and replace defective concrete.
- .14 Pour concrete continuously between predetermined construction and control joints.
- .15 Locate construction joints in wall and footings so as to least impair the strength of the structure and to the Departmental Representative's approval. Construction joints shall be keyed and 15 M dowels x 1070 long at 600 c/c shall be added. Reinforcing shall not be interrupted.
- .16 Carry out winter concreting in strict accordance with CAN/CSA-A23.1.
- .17 Finishing and Curing:
 - .1 Finish concrete in accordance with CSa-A23.1/A23.2.
 - .1 Schedule: see Architectural drawings and specifications.

- .2 Use procedures as reviewed by Departmental Representative to remove excess bleed water. Ensure surface is not damaged.
- .3 Concrete for slab-on-grade shall be cured for minimum 7 days at a minimum temperature of 10°C and for time necessary to attain 70% of the specified compressive strength.
- .18 Apply cementitious crystalline concrete waterproofing coating system in accordance with manufacturer's requirements and recommendations.

3.3 FIELD QUALITY CONTROL

- .1 Inspection and testing of concrete and concrete materials will be carried out by a third party qualified testing laboratory hired by the Contractor in accordance with CAN/CSA-A23.1/A23.2. Testing results will be supplied to the Departmental Representative.
 - .1 Site tests: conduct tests as follows in accordance with Section 01 45 00 - Quality Control and submit reports for the following items:
 - .1 Concrete pours.
 - .2 Slump.
 - .3 Air Content.
 - .4 Compressive Strength at 3, 7, 14, 28 and 56 days.
 - .5 Air and concrete temperature.
 - .2 For compressive strength testing of concrete a minimum of 4 cylinders and 3 field cured cylinders are required for:
 - .1 Each day's pour.
 - .2 Each type of grade of concrete.
 - .3 Each change of supplier.
 - .1 Each 50 cubic meter or fraction thereof for footings and foundation walls.
 - .2 Test cylinders are required for testing at the indicated days and as per requirements of CAN/CSA A23.2/A23.2 and CSA-A3000.
 - .3 Additional test specimen shall be taken whenever requested by the Departmental Representative to verify the concrete quality.
 - .3 Cure cylinders on job site under same conditions as concrete that they represent.
 - .4 Non-destructive Methods for Testing Concrete shall be in accordance with CAN/CSA-A23.2.

- .5 Minimum 4 weeks prior to starting concrete work, submit proposed quality control procedures for Departmental Representative's approval.
 - .1 Uniform finishes.
 - .2 Cold weather concreting.
 - .3 Hot weather protection.
 - .4 Curing.

3.4 SURFACE TOLERANCE

- .1 Concrete tolerance in accordance with CSA-A23.1/A23.2. Straight edge method, Class A. Floor flatness as indicated. Slab on grade minimum flatness /Levelness to be FF20/FL15, unless noted elsewhere.

3.5 CONCRETE COVER OVER REINFORCEMENT

- .1 Ensure reinforcement steel is placed to specified tolerances.
- .2 Concrete cover around reinforcing steel shall be as follows unless noted on drawings:
 - .1 Surfaces placed against soil: 75 mm.
 - .2 Pilasters (to vertical bars): 50 mm.
 - .3 Walls and grade beams: 40 mm.
 - .4 Slab on grade, bottom = 50 mm. Top = 60 mm.
 - .5 Suspended slabs, bottom: 50 mm. Top = 50 mm.
 - .6 Tank walls: 60mm. Tank base top = 60 mm.
- .3 Provide continuous supervision during the placement of concrete to ensure that the reinforcing steel is maintained in its correct position.
- .4 The preceding clear covers to be maintained within 5 mm.
- .5 Tank Walls = 60 mm, tank base, top = 60 mm.
- .6 Suspended slabs, bottom = 40 mm, top = 40 mm.

3.6 FINISHING

- .1 Finish concrete in accordance with CAN/CSA-A23.1.
 - .1 Coordinate with Section 03 35 00 – Concrete Finishing.
- .2 Use procedures acceptable to Departmental Representative to remove excess bleed water. Ensure surface is not damaged.
- .3 Use curing compounds compatible with applied finish on concrete.
- .4 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise indicated.
- .5 Protect finished installation in accordance with manufacturer's instructions.
- .6 Provide the following finishes to concrete surfaces:
 - .1 Walls and pilasters above grade: smooth form finish.
 - .2 Concrete pads: broom finish with grain in direction of slope (water flow). Do not steel trowel surface.
 - .3 Slab-on-grade:
 - .1 Steel trowel slab finish in accordance with Class A Finish Classification, CAN/CSA-A23.1, unless indicated otherwise.
- .7 Broom finish: concrete shall be placed, struck off, consolidated and screeded, the surface shall be bull floated and given a light broom finish leaving a sand-textured finish.
- .8 Slab on grade: to be non-slip surface.
 - .1 Sawcut control joints shall be made with cutting beams done at the earliest timing that will not cause raveling of the joints.

3.7 CURING

- .1 Cure concrete in accordance with CAN/CSA-A23.1.
 - .1 Coordinate with 03 35 00 – Concrete Finishing.
- .2 Ensure that freshly placed concrete is protected from freezing, dehydration, mechanical shock and contact with injurious substances.

- .3 Protect concrete from premature drying and extremes of temperature. Unless noted otherwise, cure at a temperature of at least 10°C for a minimum period of 7 days.
- .4 Concrete slab-on-grade ramps and pads shall be cured in accordance with CAN/CSA A23.1, curing Type "2". Cure for 7 days at a minimum temperature of 10°C and for the time necessary to attain 70% of the specified compressive strength. Water core shall be done in accordance with CAN/CSA-A23.1 and shall be done by:
 - .1 Absorptive mat or fabric kept continuously wet.
 - .2 Curing mats shall be wet when applied and in intimate contact with concrete surface for duration of moist curing period. Mats shall cover entire width and edges of concrete and lapped at joints. Mats shall be applied to concrete immediately after disappearance of surface water sheen and after the final finishing pass.
- .5 Foot traffic shall be kept off curing concrete for 1 day.
- .6 Vehicles shall be kept off concrete for 7 days.
- .7 Do not use curing compounds that would have a detrimental effect on bonding, adhesion, curing, appearance, or similar qualities of materials applied to concrete surfaces. Use only moisture curing for surfaces where finishes are incompatible with curing compound.
- .8 Apply floor sealer as per manufacturer's recommendations to concrete slabs, ramps and pads.

3.8 DEFECTIVE WORK

- .1 Repairs and classification of unacceptable concrete to be in accordance with CAN/CSA-A23.1.
- .2 Remove defective concrete and embedded debris and repair as directed by Departmental Representative.
- .3 Remove to bare concrete curing compounds detrimental to application of specified finishes.
- .4 Concrete to be supplied at the minimum strength requirement at 28 days. Tests indicating strengths lower than specified will necessitate further testing as required by the Departmental Representative. Cost for such testing to be at the Contractor's expense. Should further tests confirm low values, the Departmental Representative has the right to require strengthening of the affected area or removal and replacing of the weak concrete all to the Contractor's expense.

- .5 Repair all shrinkage cracks in the completed concrete surfaces to remain exposed employing a suitable epoxy injection technique acceptable to Departmental Representative to completely seal all such cracks, all to the Contractor's expense.

3.9 TOLERANCES

- .1 Concrete tolerance in accordance with CAN/CSA-A23.1.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Division 01 - General Requirements..
- .2 Section 03 10 00 - Concrete Forming and Accessories.
- .3 Section 03 20 00 - Concrete Reinforcing.
- .4 Section 03 30 00 - Cast-in-Place Concrete.
- .5 Section 07 92 00 - Joint Sealants.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-25.20-95, Surface Sealer for Floors.
- .2 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1-09/A23.2-09, Concrete Materials and Methods Concrete of Construction.
- .3 ASTM International
 - .1 ASTM C309-11, Standard Specification for Liquid Membrane Forming Compound for Curing Concrete.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Performance Requirements:
 - .1 Product quality and quality of work in accordance with Section 01 61 00 - Product Requirements.
 - .2 Submit written declaration that components used are compatible and will not adversely affect finished flooring products and their installation adhesives.
- .2 Product Data:
 - .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Provide manufacturer's printed product literature and data sheets for concrete finishes and include product characteristics, performance criteria, physical size, finish and limitation.
 - .3 Include application instructions for concrete floor treatments.

1.4 ENVIRONMENTAL REQUIREMENTS

- .1 Temporary lighting:
 - .1 Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 sq m of floor being treated.
- .2 Electrical power:
 - .1 Provide sufficient electrical power to operate normally equipment used during construction.
- .3 Work area:
 - .1 Make the work area water tight protected against rain and detrimental weather conditions.
- .4 Temperature:
 - .1 Maintain ambient temperature of not less than 10°C from 7 days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40% during same period.
- .5 Moisture:

- .1 Ensure concrete substrate is within moisture limits prescribed by flooring manufacturer.
- .6 Safety:
 - .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.
- .7 Ventilation:
 - .1 Provide continuous ventilation during and after coating application.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common Products Requirements and with manufacturer’s written instruction.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labeled with manufacturer’s name, address.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- .1 Product quality and quality of work in accordance with Section 01 61 00 – Product Requirements.
- .2 Submit written declaration that components used are compatible and will not adversely affect finished flooring products and their installation, adhesives.

2.2 SEALING/CURING COMPOUNDS

- .1 Acceptable Products:
 - .1 Sika: Sika-Florseal WB 25.
 - .2 BASF Systems: Kure 1315.

- .3 W.R. Meadows: Vocomp-30.
- .2 For concrete floors with floor hardener, provide product compatible with floor hardener.
- .3 Joint Filler and Sealants: as recommended by sealer manufacturer, to be approved. Coordinate with Section 07 92 00 – Joint Sealants.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verify that slab surfaces are ready to receive work and elevations are as indicated on shop drawings.

3.2 APPLICATION

- .1 After floor treatment is dry, seal control joints and joints at junction with vertical surfaces with sealant.
- .2 Apply floor treatment in accordance with Sealer manufacturer's written instructions.
- .3 Clean overspray. Clean sealant from adjacent surfaces.

3.3 CLEANING

- .1 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.

3.4 PROTECTION

- .1 Protect finished installation in accordance with manufacturer's instructions.

3.5 SCHEDULE OF FINISHES

- .1 Unformed Surfaces:
 - .1 Tops of Walls, Exposed Beams, Parapets and Planters: Screed to elevations and sill slopes as required, and hand trowel to tolerances. Bullnose or chamfer exposed edges unless noted otherwise on the drawings.
 - .2 Stairs, Interior ramps and slabs, top of beams and walls: Trowel finish: after the concrete has been placed, struck-off, consolidated, and screeded, the surface shall be bull floated and steel trowel to produce a smooth, dense surface with abrupt irregularities no greater than 0.8 mm and out-of planeness, no greater than 3 mm in 3 m. Areas not complying with specified tolerances shall be ground until tolerances are met, using power grinding equipment.
 - .3 DO NOT USE CURING/SEALING COMPOUNDS ON SLABS WHERE IT WILL NEGATIVELY EFFECT INSTALLATION OF FLOOR FINISHES.
 - .4 For exterior sidewalks, stairs and ramps where non-slip finish is required. Broom finish: Concrete shall be placed as concrete finish above except after floating, shall be given a light broom finish by drawing the broom perpendicular to the length of the sidewalk or slab, leaving a sand textured finish.
 - .5 For Slabs to receive setting beds or topping (if required). Raked Finish: Concrete shall be placed as in trowelled finish above, except that the surface, after floating, shall be coarsely textured with a wire rake to give an amplitude of approximately 6 mm.
 - .6 Concrete Floors:
 - .1 Generally concrete shall be natural grey coloured.
 - .2 Floor slabs shall be finished by screeding, floating, and trowelling in accordance with CSA A23.1. The finish shall be better than Class A, as described in Table 22 (Slab and Floor Finish Classifications) of CSA A23.1. Final finishing shall be done by hand trowelling, to bring the surface to a dense, blemish free condition. Slab on grade minimum flatness/levelness to be FF20/FL15, unless noted otherwise.

- .3 As soon as trowelling has been completed, continuous saturation curing, for 7 days minimum, shall be implemented. Acceptable procedures include ponding or continuous sprinkling, absorptive mat or fabric kept continuously wet, but curing compounds and polyethylene without fabric are not acceptable.
 - .4 At slab-on-grade locations construction joints and sawcut control joints shall be made, to reduce cracking, with cutting being done at the earliest timing that will not cause ravelling of the joints. The Departmental Representative will decide on the location of the joints. Control joints to coincide with floor patterns.
 - .5 Apply sealer in strict accordance with manufacturers instructions.
 - .6 Maintain uniformity of special finishes over construction joint, unless otherwise indicated.
 - .7 Locate 12 mm expansion joints at slab-on-grade perimeter, and at each change of materials and planes, unless otherwise indicated.
 - .8 Extend joint fillers full width and depth of joint, not less than 12 mm or more than 25 mm below finished surface where joint (as recommended by manufacturer), sealant is indicated. Place top of joint filler flush with finished concrete surface when no joint sealant is required.
 - .9 Furnish joint fillers in one-piece lengths for full width being placed wherever possible. Where more than one length is required, lace or clip joint filler sections together.
 - .10 Protect top edge of joint filler during concrete placement with a metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
 - .11 Refer to related sections for approved joint filler and joint sealant materials for sawcut and construction joints.
- .2 Formed Surfaces:
- .1 As-Cast Exposed Concrete: Excellent quality concrete requiring no further finish.
 - .2 Waterproofed Surfaces (backfilled sides of walls and planters): Concrete that requires no finish after form removal except projections or fins greater than 1.5 mm, honeycombing or voids larger than 6 mm deep and 3 mm diameter and more than five (5) in any 6,500 sq mm, shall be ground and patched. All cone holes patched flush. (Generally requires a grind and sacked finish to satisfy these requirements).
 - .3 Concealed Surfaces (non-exposed areas behind suspended ceilings soffits or wall furring): As stripped but repaired in accordance with CAN/CSA A23.1 where required for structural reasons.

Part 1 General

1.1 SECTION INCLUDES

- .1 Mortar and grout for masonry.

1.2 RELATED SECTIONS

- .1 Section 04 23 00 - Glass Unit Masonry: Installation of mortar.
- .2 Section 04 26 19 - Reinforced Unit Masonry: Installation of grout and mortar.
- .3 Section 08 11 13 - Standard Hollow Metal Frames: Grouted steel door frames.

1.3 REFERENCES

- .1 ASTM C494/C494M-10a - Standard Specification for Chemical Admixtures for Concrete.
- .2 ASTM C780-10 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
- .3 CAN/CSA-A179-04 (R2009) - Mortar and Grout for Unit Masonry.
- .4 CAN/CSA-A371-04 (R2009) - Masonry Construction for Buildings.
- .5 CAN/CSA-A3000-08 - Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .6 CSA-S304.1-04 (R2010) - Design of Masonry Structures.

1.4 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Include design mix, indicate whether the Proportion or Property specification of CSA-A179 is to be used, required environmental conditions, and admixture limitations.

1.5 CLOSEOUT SUBMITTALS

1.6 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.
- .2 Maintain packaged materials clean, dry, and protected against dampness, freezing, and foreign matter.

1.7 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 26: Environmental conditions affecting products on site.
- .2 Maintain materials and surrounding air temperature to minimum 5 degrees C prior to, during, and 48 hours after completion of masonry work.
- .3 Cold and Hot Weather Requirements: CAN/CSA-A371 - Masonry Construction for Buildings.

Part 2 Products

2.1 MATERIALS

- .1 Cementitious Material: CAN/CSA-A179.
 - .1 Portland Cement: CSA-A3001, Type GU, grey colour.
 - .2 Masonry Cement: CSA-A3002, Type S, white grey colour.
 - .3 Mortar Cement: CSA-A3002.
- .2 Mortar Aggregate: CAN/CSA-A179, fine aggregate.
- .3 Grout Aggregate: CAN/CSA-A179, fine aggregate.
- .4 Water: Clean and potable.
- .5 Premix Mortar: CAN/CSA-A179, Type S, using grey colour cement.

2.2 ADMIXTURES

- .1 Chemical Admixture: ASTM C494/C494M.

2.3 MORTAR MIXES

- .1 Mortar for Exterior Above Grade:
 - .1 Loadbearing Walls: CAN/CSA-A179, Type S using the Proportion specification.
 - .2 Non-Loadbearing Walls: CAN/CSA-A179, Type N using the Proportion specification.
- .2 Mortar for Glass Unit Masonry: CAN/CSA-A179, Type S using the proportion specification with integral-type waterproofer as recommended by block manufacturer.

2.4 MORTAR MIXING

- .1 Mix mortar ingredients to CAN/CSA-A179 in quantities needed for immediate use.
- .2 Add mortar colour to manufacturer's written instructions. Provide uniformity of mix and colouration.
- .3 Do not use antifreeze liquids, calcium chloride, frost inhibitors based on calcium chloride, salts or other substances used for lowering the freezing point or accelerating setting time.
- .4 If moisture is lost by evaporation, retemper with water in quantities and at intervals sufficient to restore workability.
- .5 Use mortar within period specified by mortar manufacturer.

2.5 GROUT MIXES

- .1 Lintels and Bond Beams: 21 Mpa strength at 28 days; 200-250 mm slump; premixed type to CAN/CSA-A179.

- .2 Engineered Masonry: 21 Mpa strength at 28 days; 200-250 mm slump; premixed type to CAN/CSA-A179.

2.6 GROUT MIXING

- .1 Mix grout to CAN/CSA-A179.
- .2 Thoroughly mix grout ingredients in quantities needed for immediate use to CAN/CSA-A179, Fine grout.
- .3 Add admixtures in to manufacturer's written instructions; mix uniformly.
- .4 Do not use antifreeze liquids, calcium chloride, frost inhibitors based on calcium chloride, salts or other substances used for lowering the freezing point or accelerating setting time.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Request inspection of spaces to be grouted.

3.2 PREPARATION

- .1 Apply bonding agent to existing concrete surfaces.
- .2 Plug clean-out holes with block masonry units. Brace masonry for wet grout pressure.

3.3 INSTALLATION

- .1 Install mortar and grout to CAN/CSA-A179.

3.4 FIELD QUALITY CONTROL

- .1 Section 01 45 00: Test mortar.
- .2 Test mortar mix to CAN/CSA-A179.
- .3 Test mortar mix to CAN/CSA-A179 for water content.
- .4 Test grout mix to CAN/CSA-A179 for slump.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Continuous wire reinforcement and reinforcing rods.
- .2 Masonry anchors and ties.

1.2 RELATED SECTIONS

- .1 Section 04 26 19 - Reinforced Unit Masonry.

1.3 REFERENCES

- .1 ASTM A82/A82M-07 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
- .2 ASTM A123/A123M-09 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .3 ASTM A153/A153M-09 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- .4 ASTM A307-10 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
- .5 CSA-A23.1-09/A23.2-09 - Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .6 CSA-G30.18-09 - Carbon Steel Bars for Concrete Reinforcement.
- .7 CSA-G40.20-04/G40.21-04 (R2009) - General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel.
- .8 CAN/CSA-A370-04 (R2009) - Connectors for Masonry.
- .9 CAN/CSA-A371-04 (R2009) - Masonry Construction for Buildings.
- .10 CSA-S304.1-04 (R2010) - Design of Masonry Structures.

Part 2 Products

2.1 MATERIALS

- .1 Steel Wire: ASTM A82/A82M.
- .2 Steel Bars, Plates, Angles: CSA-G30.18-09 and CAN/CSA-G40.21, Type W.
- .3 Steel Bolts: ASTM A307, Type A.

2.2 MASONRY CONNECTORS

- .1 Joint Reinforcement : CAN/CSA-A371-04, continuous cold draw steel wire and hot dip galvanized to ASTM A123/A123M after fabrication type, 3.7 mm (0.146 inches) side rods and cross ties.

- .2 Wall Ties (Wire): CAN/CSA-A371-04, formed steel type for attachment to concrete structure..
 - .1 Manufactures:
 - .2 Blok-Lok; Product: BLT-8.
- .3 Bar Anchors: CAN/CSA-CSA-A371-04, hot dipped galvanized to ASTM A123/A123M after fabrication.
- .4 Bolt and Rod Anchors: CAN/CSA-A371-04, formed steel rods, hot dipped galvanized to ASTM A123/A123M after fabrication.
- .5 Bar Reinforcing Steel: CSA-G30.18, Grade 400W , deformed billet bars, uncoated finish.
- .6 Hardware and Bolts: uncoated

2.3 FABRICATION

- .1 Fabricate connectors to CAN/CSA-A371-04.
- .2 Fabricate bar reinforcing to CSA-A23.1/A23.2.

Part 3 Execution

3.1 INSTALLATION

- .1 Install anchors and reinforcing as indicated in masonry Section 04 26 19

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Glass masonry units.
- .2 Mortar bed and pointing mortar.
- .3 Perimeter treatment.

1.2 RELATED SECTIONS

- .1 Section 04 04 05 - Mortar and Masonry Grout: Mortar for glass unit masonry.
- .2 Section 04 04 15 - Masonry Anchorage and Reinforcement.
- .3 Section 04 26 19 - Reinforced Unit Masonry
- .4 Section 07 62 00 - Sheet Metal Flashing and Trim: flashing and Sill construction under glass unit masonry.
- .5 Section 07 92 00 - Joint Sealants: Perimeter caulking.

1.3 REFERENCES

- .1 CAN/CSA-A179-04 (R2009) - Mortar and Grout for Unit Masonry.
- .2 CAN/CSA-A370-04 (R2009) - Connectors for Masonry.
- .3 CAN/CSA-A371-04 (R2009) - Masonry Construction for Buildings.
- .4 CSA-S304.1-04 (R2010) - Design of Masonry Structures.

1.4 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data for glass units.

1.5 QUALITY ASSURANCE

- .1 Products of This Section: Manufactured to ISO 9000 certification requirements.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.
- .3 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.

1.6 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.
- .2 Accept glass units on site on pallets; inspect for damage.

1.7 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 26: Environmental conditions affecting products on site.
- .2 Maintain materials and surrounding air temperature to minimum 5 degrees C prior to, during, and 48 hours after completion of masonry work.

Part 2 Products

2.1 GLASS UNITS

- .1 Solid Glass Units: special end units; with joint key to assist mortar bond.
 - .1 Nominal Size: 140 mm x 400mm
 - .2 Colour: Clear glass.
 - .3 Pattern and Design: translucent.
 - .4 Compressive Strength: 2.8-4.1 MPa.

2.2 ACCESSORIES

- .1 Joint Reinforcement: galvanized after fabrication, butt-welded steel ladder ties, as specified in Section 04 04 15.
- .2 Panel Anchors: corrugated, hot-dipped galvanized after fabrication steel anchors, as specified in Section 04 04 15.
- .3 Security Bars: grout anchor vertical steel reinforcing bars through centre of glass block. Refer to Architectural drawings for detail.
- .4 Perimeter Channel: Extruded aluminum channel profile, 120 x 32 x 3 mm size, one (1) piece per length installed, uncoated finish.
- .5 Expansion Strips: Continuous glass fibre strips, 10 x 100 mm nominal size.
- .6 Asphalt Emulsion: Water based.
- .7 Sealant Backing Material: Polyethylene foam, neoprene, or filler as recommended by the sealant manufacturer.

2.3 MORTAR MATERIAL

- .1 Mortar: CAN/CSA-A179, Type N, as specified in Section 04 04 05.
- .2 Sealant: C type, as specified in Section 07 92 00.

2.4 MIX TESTS

- .1 Test mortar mix as specified in Section 04 04 05.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.

- .2 Verify that openings are ready to receive work.
- .3 Verify that field measurements are as indicated.

3.2 PREPARATION

- .1 Clean glass units of substances that may impair bond with mortar or sealant.
- .2 Establish and protect lines, levels, and coursing.
- .3 Protect elements surrounding the work of this section from damage or disfiguration.

3.3 INSTALLATION

- .1 Erect glass units and accessories to manufacturer's written instructions.
- .2 Locate and secure perimeter metal chase.
- .3 Coat sill under units with asphalt emulsion as a bond breaker, and allow to dry.
- .4 Set panel anchors in mortar bed directly over coating.
- .5 Provide full mortar joints. Furrowing not permitted. Remove excess mortar.
- .6 Joint width for straight walls uniform 6 mm.
- .7 Joint width on outside head joint for curved walls minimum 3 mm.
- .8 Install joint reinforcement and anchors.
- .9 Place joint reinforcement at every other horizontal joint where courses are less than 200 mm high and at every horizontal joint where courses are more than 200 mm high. Place reinforcement in full mortar bed and at first course above and below openings within the glass unit panel.
- .10 Lap reinforcement joints 150 mm. Discontinue reinforcement at expansion joints.
- .11 Anchor panels to lateral supports at panel jambs and head, located at each horizontally reinforced mortar joint. Extend anchors minimum 300 mm into joint.
- .12 Isolate panel from adjacent construction on sides and top with expansion strips concealed within perimeter trim. Keep expansion joint voids clear of mortar.
- .13 Shore assembly until setting bed will maintain panel in position without movement.
- .14 To accommodate pointing mortar, rake out joints 16 to 19 mm.
- .15 Rake out joint 10 mm to accommodate sealant.
- .16 Fill joints with pointing mortar. Pack into voids. Neatly tool surface to a concave profile.
- .17 Place sealant in mortar joints in accordance with Section 07 92 00. Tool surface to a concave profile.
- .18 Remove excess sealant.

3.4 PROVISION FOR MOVEMENT

- .1 Leave 10 mm deflection space below shelf angles. Insert foam rod and sealant as specified in Section 07 92 00.
- .2 Leave 10 mm space between top of non-loadbearing wall and structural elements. Do not use wedges.
- .3 Movement joints minimum 10 mm.

3.5 ERECTION TOLERANCES

- .1 Section 01 73 00: Tolerances.
- .2 Maximum Variation from Plane of Unit to Adjacent Unit: 1.6 mm.
- .3 Maximum Variation of Panel from Plane: 3 mm.

3.6 CLEANING

- .1 Section 01 74 00: Cleaning installed work.
- .2 Do not scratch or deface units.

3.7 PROTECTION OF FINISHED WORK

- .1 Section 01 78 40: Protecting installed work.
- .2 Maintain temperature of glass unit masonry above 5 degrees C or seventy-two (72) hours after construction.
- .3 Maintain protective boards at exposed external corners. Provide protection without damaging completed work.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Common work results for reinforced unit masonry construction.
- .2 Miscellaneous masonry flashing and accessories.

1.2 RELATED SECTIONS

- .1 Section 04 04 05 - Mortar and Masonry Grout: Mortar and grout.
- .2 Section 04 04 15 - Masonry Anchorage and Reinforcement: Connectors and reinforcing.
- .3 Section 04 23 00 - Glass Unit Masonry.
- .4 Section 05 50 00 - Metal Fabrications: Loose steel lintels.
- .5 Section 07 84 00 - Firestopping: Firestopping at penetrations of masonry work.
- .6 Section 07 92 00 - Joint Sealants: Rod and sealant at control joints.
- .7 Section 11 15 00 - Detention Cell Doors, Frames, and Hardware.

1.3 REFERENCES

- .1 CAN/CSA-A370-04 (R2009) - Connectors for Masonry.
- .2 CAN/CSA-A371-04 (R2009) - Masonry Construction for Buildings.
- .3 CSA-S304.1-04 (R2010) - Design of Masonry Structures.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
- .3 Pre-installation Meetings: Convene one (1) week before starting work of this section.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data for concrete masonry units and fabricated wire reinforcement.
- .3 Shop Drawings: Indicate bars sizes, spacings, locations, reinforcement quantities, bending and cutting schedules, supporting and spacing devices for reinforcement, accessories, and associated materials.

1.6 CLOSEOUT SUBMITTALS

1.7 QUALITY ASSURANCE

- .1 Perform Work to CSA-S304.1 and CAN/CSA-A371. Maintain one (1) copy of each document on site.
- .2 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.

1.8 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for requirements for fire rated masonry construction.

1.9 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Deliver, store, protect and handle products to site.
- .2 Package and protect masonry units to arrive undamaged at the job site.
- .3 Store masonry under waterproof cover on pallets or plank platforms held off ground.

1.10 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 26: Environmental conditions affecting products on site.
- .2 Maintain materials and surrounding air temperature to minimum 5 degrees C prior to, during, and forty-eight (48) hours after completion of masonry work.
- .3 Cold and Hot Weather Requirements: CAN/CSA-A371 - Masonry Construction for Buildings.

Part 2 Products

2.1 CONCRETE BLOCK MASONRY UNITS

- .1 Concrete Block Units (CMU): Specified in Section 04 04 25.
- .2 Fire Resistant Block Units: Specified in Section 04 04 25.

2.2 REINFORCEMENT AND ANCHORAGE

- .1 Joint Reinforcement: As Specified in Section 04 04 15.
- .2 Bar Reinforcing Steel: As Specified in Section 04 04 15.
- .3 CMU Anchors: As Specified in Section 04 04 15.
- .4 Steel Angles: Specified in Section 05 50 00.

2.3 MORTAR AND GROUT

- .1 Mortar and Grout: Type as specified in Section 04 04 05

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that field conditions are acceptable and are ready to receive work.
- .2 Verify items provided by other sections of work are properly sized and located.
- .3 Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

- .1 Direct and coordinate placement of metal anchors supplied to other Sections.
- .2 Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.
- .3 Verify that items built-in under other sections are properly located and sized.

3.3 COURSING

- .1 Build masonry plumb, level, and true to line, with vertical joints in alignment.
- .2 Establish lines, levels, and coursing indicated. Protect from displacement.
- .3 Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- .4 Concrete Masonry Units:
 - .1 Bond: Running.
 - .2 Coursing: One (1) unit and one (1) mortar joint to equal .200 mm (8 inches).
 - .3 Mortar Joints: Concave.

3.4 PLACING AND BONDING

- .1 Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- .2 Lay hollow masonry units with face shell bedding on head and bed joints.
- .3 Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
- .4 Remove excess mortar as work progresses.
- .5 Interlock intersections and external corners.
- .6 Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- .7 Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges. Provide safe work procedures and control cutting dust from affecting adjacent work areas.

- .8 Cut mortar joints flush where where wall tile is scheduled and where resilient base is scheduled.
- .9 Isolate masonry partitions from vertical structural framing members with a control joint as indicated.

3.5 PROVISION FOR MOVEMENT

- .1 Leave foam rod and sealant deflection space below shelf angles. Insert 6 mm (1/4 inch) as specified in Section 07 92 00.
- .2 Leave 13 mm (1/2 inch) space between top of non-loadbearing wall and structural elements. Do not use wedges.

3.6 REINFORCEMENT AND ANCHORAGE

- .1 Install masonry connectors and reinforcement to CAN/CSA-A370 and CAN/CSA-A371.
- .2 Place joint reinforcement vertically spaced to CAN/CSA 371.
- .3 For stack bond joint install joint and corner reinforcing at every course.
- .4 Lap joint reinforcement ends minimum 13 mm (1/2 inch)
- .5 Reinforce and grout masonry units and bond beams to CAN/CSA-A371.
- .6 Install vertical reinforcing steel with a minimum clearance of 13 mm (1/2 inch) from the masonry and not less than one bar diameter between bars.
- .7 Secure reinforcing steel in place. Inspect steel connections before grouting.
- .8 Provide cleanout openings at bottom of cores containing reinforcement.
- .9 Fill cells containing reinforcement and anchor bolts solidly with grout.

3.7 LINTELS

- .1 Install loose steel lintels, centred over openings.
- .2 Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled, to CAN/CSA-A371.
- .3 Maintain minimum 200 mm (8 inch) bearing on each side of opening.

3.8 LATERAL SUPPORT AND ANCHORAGE

- .1 Install lateral support and anchorage as indicated.
- .2 Space supports and anchors attached to structural steel members to CAN/CSA-A370, CAN/CSA-A371 and CSA-S304.1.

3.9 SUPPORT OF LOADS

- .1 Grout bond beams as indicated on the drawings.
- .2 Use grout to CAN/CSA-A179 where grout is used in lieu of solid units.
- .3 Use 21 MPa strength concrete where concrete is used in lieu of solid units.

- .4 Install building paper below voids to be filled with grout; keep paper 25 mm back from face of units.

3.10 ENGINEERED MASONRY

- .1 Lay masonry units with core cells vertically aligned clear of mortar and unobstructed.
- .2 Reinforce masonry unit cores with reinforcement bars and grout to CAN/CSA-A179, CAN/CSA-A371 and CSA-S304.1.

3.11 MOVEMENT JOINTS

- .1 Provide continuous control joints as indicated.
- .2 Do not continue horizontal joint reinforcement through control joints and expansion joints.
- .3 Break vertical mortar bond with sheet building paper fitted to one side of the hollow contour end of the block unit. Fill the resultant elliptical core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.
- .4 Size control joint as specified in Section 07 92 00 for sealant performance.
- .5 Form expansion joint as detailed.

3.12 BUILT-IN WORK

- .1 As work progresses, install built-in anchor bolts and metal door frames and other items to be built-in the work and furnished by other sections.
- .2 Install built-in items plumb and level. The plumbness of walls containing Detention Cell Doors (08 34 55) require strict attention to accepted tolerances.
- .3 Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout. Fill adjacent masonry cores with grout minimum 300 mm (12 inches) from framed openings.
- .4 Do not build in organic materials subject to deterioration.

3.13 ERECTION TOLERANCES

- .1 Section 01 73 00: Tolerances.
- .2 Tolerances for unit masonry as recommended in CAN/CSA-A371.
- .3 Note associated critical tolerances in Section 08 34 55 - Detention Cell Doors, Frames, and Hardware.

3.14 CUTTING AND FITTING

- .1 Cut neatly for electrical switches, outlet boxes and other recessed or built-in objects. Coordinate with other sections of work to provide correct size, shape, and location.
- .2 Make cuts straight, clean and free of uneven edges.

- .3 Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.15 FIELD QUALITY CONTROL

- .1 Section 01 45 00: Field inspection.
- .2 Inspect all engineered masonry work.

3.16 CLEANING

- .1 Section 01 74 00: Cleaning installed work.
- .2 Remove excess mortar and mortar smears as work progresses.
- .3 Replace defective mortar. Match adjacent work.
- .4 Clean soiled surfaces with cleaning solution.
- .5 Use non-metallic tools in cleaning operations.

3.17 PROTECTION OF FINISHED WORK

- .1 Section 01 78 40: Protecting installed work.
- .2 Without damaging completed work, provide protective boards at exposed external corners which may be damaged by construction activities.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTION

- .1 Division 01 - General Requirements.
- .2 Section 03 30 00 - Cast-In-Place Concrete.
- .3 Section 04 05 19 - Masonry Anchorage and Reinforcing.
- .4 Section 04 05 00 - Common work Results for Masonry
- .5 Section 06 40 00 - Architectural Woodwork.
- .6 Section 09 90 00 - Painting.
- .7 Section 10 99 00 - Miscellaneous specialties: Bollard Sleeves.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM A53/A53M-12, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A123/A123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .3 ASTM A269-14, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - .4 ASTM A307-12, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .5 ASTM A325-10, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - .6 ASTM A325M-13, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric).
 - .7 ASTM A641/A641M-09a, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - .8 ASTM A536-84(2009), Standard Specification for Ductile Iron Castings.

- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.40-97, Anti-corrosive Structural Steel Alkyd Primer.
 - .2 CAN/CGSB-1.181-92, Ready-Mixed, Organic Zinc-Rich Coating.
- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA-S16-09 - Design of Steel Structures.
 - .3 CSA-W48-14, Filler Metals and Allied Materials for Metal Arc Welding.
 - .4 CSA-W59-03(R2008), Welded Steel Construction (Metal Arc Welding).
- .4 Health Canada / workplace Hazardous Materials Information system (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual – current edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit two copies of WHMIS MSDS in accordance with Section 01 33 00 - Submittal Procedures.
 - .3 Indicate VOC's:
 - .1 For finishes, coatings, primers and paints.
- .2 Shop Drawings
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.
- .3 Shop Drawings must be signed and sealed by a Professional Engineer licensed in the Province of Nova Scotia, Canada.

1.4 QUALITY ASSURANCE

- .1 Test Reports: Submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: Submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Pre-installation Meetings: Conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.
- .4 Design metal fabrications under direct supervision of a Professional Engineer experienced in design of this Work and licensed in the Province of Nova Scotia, Canada.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, Shipping, Handling and Unloading:
 - .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 -Product Requirements and with manufacturer's written instruction.
 - .2 Deliver materials to site in original factory packaging, labeled with manufacturer's name and address.
- .2 Storage and Protection
 - .1 Cover exposed stainless steel surfaces with pressure sensitive heavy protection paper or apply strippable plastic coating, before shipping to job site.
 - .2 Leave protective covering in place until final cleaning of building. Provide instructions for removal of protective covering.
 - .3 Store materials in dry location and in accordance with manufacturer's recommendation in clean dry well ventilated area.
 - .4 Replace defective or damaged materials with new.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20 - Waste Managing and Disposal.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Steel sections and plates: to CAN/CSA-G40.20/G40.21, Grade 300W, or as indicated in the drawings.
- .2 Steel pipe: to ASTM A53/A53M standard weight or galvanized finish for exterior work.
- .3 Ductile Iron: to ASTM A536.
- .4 Welding materials: to CSA W59.
- .5 Welding electrodes: to CSA W48 Series.
- .6 Bolts and anchor bolts: to ASTM A307.
- .7 Anchor rods: to ASTM F1554, Grade 36.
- .8 High-strength bolts to ASTM A325/A325M.
- .9 Perforated Steel Plate: mild steel perforated plate, 3.4 mm thickness, perforations side staggered oblong holes 6 mm x 50 mm.
- .10 Aluminum sheet: Minimum thickness as noted on the drawings, finish No. 4 type 302.
- .11 Stainless steel tubing: to ASTM A269, Type 302 Commercial grade Seamless welded with AISI No. 4 finish.
- .12 Stainless Steel Sheet: Type 304, thickness as indicated, No. 4 finish.
- .13 Grout: non-shrink, non-metallic, flowable, 20 MPa at 24 hours.
- .14 Wire Mesh: 19 x 19 mm welded wire mesh, minimum wire thickness 1.0 mm (16 gauge), hot-dipped galvanized.

- .15 Hangar Wire: to ASTM A641/A641M, soft-annealed wire, class 1 zinc coating, minimum size 3.77 mm diameter, or material and size having equivalent corrosion resistance and strength.
- .16 Shop coat primer:
 - .1 For interior steel surfaces: MPI Approved Product No. 76 or 79, at the option of the fabricator.
 - .2 For exterior steel surfaces: MPI Approved Product No. 79.
 - .3 Touch-up primer for galvanized surfaces: Zinc-rich primer to SSPC Paint-20.
- .17 Steel floor Grating: 38 mm or 51 mm thick, hot dipped galvanized.
- .18 Steel Checker Plate: 6.4 mm thick, hot dipped galvanized.

2.2 FABRICATION

- .1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Use self-tapping shake-proof flat screws on items requiring assembly by screws or as indicated.
- .3 Where possible, fit and shop assemble work, ready for erection.

2.3 FINISHES

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600g/sq m to ASTM A123/A123M.
- .2 Shop coat primer: to minimum CAN/CGSB-1.40 and to appropriate MPI-INT or MPI-EXT specification.
- .3 Zinc primer: zinc rich, ready mix to minimum CAN/CGSB-1.181 and to appropriate MPI-INT or MPI-EXT specification.

2.4 ISOLATION COATING

- .1 Isolate aluminum from following components, by means of bituminous paint:
 - .1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
 - .2 Concrete, mortar and masonry.
 - .3 Wood.

2.5 CORROSION PROTECTION OF DISSIMILAR METALS

- .1 Protect corrosion of dissimilar metals by separation with HDPE spacers.

2.6 SHOP PAINTING

- .1 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.
- .2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 degrees C.
- .3 Clean surfaces to be field welded; do not paint.

2.7 ANGLE LINTELS

- .1 Check Architectural, Structural, Mechanical and Electrical drawings for openings or recesses in non-loadbearing walls requiring lintels, Where not otherwise specified or indicated on the structural drawings, fabricate mild steel angle lintels (one angle for each 100 mm of wall thickness) to sizes as follows:
 - .1 Up to 1200 mm span: L90 x 90 x 8.
 - .2 Up to 1800 mm span: L100 x 90 x 8 (LLV)
 - .3 Up to 1900 mm span: L125 x 90 x 8 (LLV)
 - .4 Up to 2400 mm span: L125 x 90 x 8 (LLV).
- .2 All lintels in bearing walls are indicated on the Structural Drawings.

- .3 Weld double angles at maximum 450 mm on centre.
- .4 Provide loose lintels for installation under Section 04 26 19– Reinforced Unit Masonry.
- .5 For fixed lintels and loose lintels above openings wider than 2400 mm: refer to Structural Drawings.
- .6 Interior lintels to be shop prime coated as specified herein for paint finish by Section 09 90 00 - Painting.

2.8 ACCESS LADDERS

- .1 For component sizes and dimensions, refer to Architectural and Structural drawings.
- .2 Generally galvanized except access ladders to sump pits and below grade tanks must be constructed entirely from stainless steel.
- .3 Brackets: sizes, shapes and spacing as required to provide rigid installation, weld to stringers centre, provide anchors to suit substrate.

2.9 CHANNEL FRAMES

- .1 Fabricate frames from steel, sizes of channel and opening as indicated.
- .2 Weld channels together to form continuous frame for jambs and head of openings, sizes as indicated.
- .3 Provide anchors to suit wall construction. Installation to be rigid.
- .4 Finish: Prime coat painted.

2.10 PIPE RAILINGS

- .1
- .2 Fabricate steel pipe railing as indicated, as required and in accordance with the reviewed and accepted shop drawings.

- .3 Include stair handrails and guards, miscellaneous guards to protect equipment, other railings as indicated and as required for a complete project.
- .4 Design handrails and guards to NBC vertical and horizontal live load and dimensional requirements.
- .5 Steel pipe: 42 mm outside diameter or as indicated on Drawings, formed to shapes as indicated.
- .6 Cap exposed ends of pipe railings.
- .7 Terminate at abutting walls with end flanges.
- .8 Interior railings to be shop prime coated for paint finish by Section 09 90 00 - Painting.
- .9 Exterior railings to be hot dip galvanized after fabrication for paint finish by Section 09 90 00 - Painting.

2.11 BOLLARDS

- .1 As specified by Structural, Civil, Architectural, Mechanical or Electrical and where indicated on Drawings.
- .2 Protect with plastic bollard sleeves as specified in Section 10 99 00 - Miscellaneous Specialties.

2.12 GUARDRAILS

- .1 Engineer, supply and install all metal components for guards, railings, and handrails at stairs, and as noted on drawings.
- .2 Conform to National Building Code of Canada for structural design, locations, configuration and member spacing.
- .3 Steel tubing shall be minimum 42 mm diameter with min. 3mm wall thickness. Provide fully-welded joints. Space supports and posts at a maximum of 1500mm o.c. and not more than 300mm from ends.
- .4 Both at the top and bottom of stairs, extend top rail horizontally min.300mm beyond required sloped portion of handrail, and turn down and return to stair rail picket.

- .5 Provide radius returns at ends of handrails such as at wall-mounted handrails, and cap the ends of tube rails with 3mm steel plate and weld all around, and terminate 12mm from face of wall.
- .6 Pickets shall be minimum 12mm square or round bar, maximum 1200mm oc.
- .7 Factory-weld wherever practical to minimize field welding. Grind all welds smooth. Slightly round all edges.
- .8 All exterior metal shall be hot dipped galvanized after fabrication.
- .9 Locations as indicated on drawings.

2.13 WALK-OFF MATS

- .1 In accordance with Architectural drawings and specifications. Coordinate concrete floor slab recess with Architectural and Structural drawings.

2.14 MISCELLANEOUS METAL FRAME SUPPORTS

- .1 In accordance with Architectural, Mechanical, Fire Protection and Electrical drawings and specifications. Fabricate, supply and install miscellaneous metal frame supports for units, piping, etc. as required on drawings and specifications.
 - .1 All exterior exposed metals to be hot-dipped galvanized after fabrication.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal fabrications installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

- .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 ERECTION

- .1 Do welding work in accordance with CSA-W59 unless specified otherwise.
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .3 Provide suitable means of anchorage acceptable to Departmental Representative such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .4 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .5 Provide components for building by other sections in accordance with shop drawings and schedule.
- .6 Make field connections with bolts to CSA-S16, or weld.
- .7 Deliver items over for casting into concrete or building into masonry to appropriate trades together with setting templates to appropriate location and construction personnel.
- .8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.
- .9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

3.3 PIPE RAILINGS

- .1 Install pipe railings to locations as indicated.
- .2 Set railing standards in concrete. Grout to fill hole. Trowel surface smooth and flush with adjacent surfaces.

3.4 ACCESS LADDERS

- .1 install access ladders in locations as indicated.
- .2 Erect ladders 150 mm minimum clear of wall on bracket supports.

3.5 CHANNEL FRAMES

- .1 Install steel channel frames to openings as indicated.

3.6 BOLLARDS

- .1 Install bollards in locations as indicated.

3.7 GUARDRAILS

- .1 Install guardrails in locations as indicated.

3.8 WALK-OFF MATS

- .1 Install entrance walk-off mats in locations as indicated.

3.9 MISCELLANEOUS METAL FRAME SUPPORTS

- .1 Install metal frame supports in locations as indicated.
 - .1 Door frames for overhead door openings: welded channel sections, galvanized for exterior finish. Refer to drawing details.
 - .2 Vanity support brackets: steel angle and fastener, shop powder coated finish. Refer to drawing details.

- .3 Chain guard: floor mounted galvanized steel tube. Refer to drawing details.

3.10 CLEANING

- .1 Perform cleaning after installation.
- .2 Upon completion, remove surplus materials, rubbish, tools and equipment.

3.11 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by metal fabrications installations.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 06 17 53 - Shop - Fabricated Wood Trusses.
- .3 Section 06 18 00 - Glued-Laminated Construction.

1.2 REFERENCES

- .1 American National Standards Institute/National Particleboard Association (ANSI/NPA)
 - .1 ANSI/NPA A208.1-2009, Particleboard.
- .2 ASTM International
 - .1 ASTM A 123/A 123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A 653/A 653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
 - .3 ASTM C 578-14, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - .4 ASTM C 1289-14, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 - .5 ASTM C 1396/C 1396M-14, Standard Specification for Gypsum Board.
 - .6 ASTM D 1761-12, Standard Test Methods for Mechanical Fasteners in Wood.
 - .7 ASTM D 5055-13e1, Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists.
 - .8 ASTM D 5456-14a, Standard Specification for Evaluation of Structural Composite Lumber Products.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-11.3-M87, Hardboard.
 - .2 CAN/CGSB-51.32-M77, Sheathing, Membrane, Breather Type.

- .3 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction and amendment.
- .4 CAN/CGSB-71.26-M88, Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems.
- .4 CSA International
 - .1 CAN/CSA-A123.2-03(R2013), Asphalt Coated Roofing Sheets.
 - .2 CAN/CSA-A247-M86(R1996), Insulating Fiberboard.
 - .3 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
 - .4 CSA O112.9-10, Evaluation of Adhesives for Structural Wood Products (Exterior Exposure).
 - .5 CSA O121-08, Douglas Fir Plywood.
 - .6 CAN/CSA O122-06(R2011), Structural Glued-Laminated Timber.
 - .7 CSA O141-05(R2009), Softwood Lumber.
 - .8 CSA O151-09, Canadian Softwood Plywood.
 - .9 CSA O153-13, Poplar Plywood.
 - .10 CSA O325-07(R2012), Construction Sheathing.
 - .11 CSA O437 Series-93(R2011), Standards on OSB and Waferboard.
 - .12 CAN/CSA-Z809-08, Sustainable Forest Management.
- .5 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2014.
- .6 The Truss Plate Institute of Canada
 - .1 Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses 2011.
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S706-09, Standard for Wood Fibre Insulating Boards for Buildings.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Nova Scotia, Canada.

1.4 QUALITY ASSURANCE

- .1 Lumber by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wood from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 FRAMING STRUCTURAL AND PANEL MATERIALS

- .1 Characteristics:
 - .1 Lumber, Glulam, I-Joists, Trusses, CAN/CSA-Z809 or FSC or SFI certified.
 - .2 Plywood. Particleboard and OSB urea-formaldehyde free, CAN/CSA-Z809 or FSC or SFI certified.
- .2 Lumber: softwood, S4S, moisture content 19% (S-dry) or less in accordance with following standards:
 - .1 CSA O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
- .3 Glulam in accordance with Structural Glued-Laminated Timber CAN/CSA-O122.
- .4 Wood I-joists in accordance with Prefabricated Wood I-Joists ASTM D 5055.
- .5 Light-frame trusses in accordance with "Truss Design and Procedures for Light Metal Connected Wood Trusses", The Truss Plate Institute of Canada.
- .6 Structural Composite Lumber (SCL) in accordance with ASTM D 5456.
- .7 Framing and board lumber: in accordance with NBC, and as indicated on the drawings.
- .8 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:
 - .1 S4S is acceptable for all indicated items.
 - .2 Board sizes: "Standard" or better grade.
 - .3 Dimension sizes: "Standard" light framing or better grade.
 - .4 Post and timbers sizes: "Standard" or better grade.
- .9 Plywood, OSB and wood based composite panels: to CSA O325.
- .10 Douglas fir plywood (DFP): to CSA O121, standard construction.
- .11 Canadian softwood plywood (CSP): to CSA O151, standard construction.
- .12 Poplar plywood (PP): to CSA O153, standard construction.
- .13 Interior mat-formed wood particleboard: to ANSI/NPA 208.1.

- .14 Mat-formed structural panelboards (OSB wafer): to CAN O437.
- .15 Insulating fiberboard sheathing: to CAN/CSA-A247 or CAN/ULC-S706.
- .16 Glass fibre board sheathing: non-structural, rigid, faced, fiberglass, insulating exterior sheathing board.
- .17 Isocyanurate sheathing: to ASTM C 1289, faced, unless indicated otherwise.
- .18 Expanded polystyrene sheathing: to ASTM C 578.
- .19 Gypsum sheathing: to ASTM C 1396/C 1396M.

2.2 ACCESSORIES

- .1 Nails, spikes and staples: to CSA B111.
- .2 Bolts: minimum 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .3 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, recommended for purpose by manufacturer.
- .4 Joist hangers: minimum 1 mm thick sheet steel, galvanized ZF001 coating designation.
- .5 Nailing discs: flat caps, minimum 25 mm diameter, minimum 0.4 mm thick, sheet metal, formed to prevent dishing. Bell or cup shapes not acceptable.
- .6 Roof sheathing H-Clips: formed "H" shape, thickness to suit panel material, extruded 6063-T6 aluminum alloy type approved by Departmental Representative.
- .7 Fastener Finishes:
 - .1 Galvanizing: to ASTM A 123/A 123M or ASTM A 653, use galvanized fasteners for exterior work pressure-preservative fire-retardant treated lumber.
 - .2 Stainless steel: use stainless steel as indicated on drawings.
- .8 Wood Preservative:
 - .1 Preservative/Coating: in accordance with manufacturer's recommendations for surface conditions:

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

- .1 Treat indicated surfaces of material with wood preservative, before installation.
- .2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber and one minute soak on plywood.
- .3 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.
- .4 Treat material as follows:
 - .1 Wood cants, fascia backing, curbs, nailers, sleepers on roof deck.
 - .2 Wood furring on outside surface of exterior masonry and concrete walls.
 - .3 Wood sleepers supporting wood subflooring over concrete slabs in contact with ground or fill.

3.3 MATERIAL USAGE

- .1 Roof sheathing (unless noted otherwise):
 - .1 Plywood, DFP or CSP sheathing grade or PP standard sheathing grade, T&G edge, minimum 16 mm thick.

- .2 Exterior wall sheathing (unless noted otherwise):
 - .1 Plywood, DFP or CSP sheathing grade or PP standard sheathing grade, T&G edge, exterior side 9.5 mm thick, otherwise 12.7 mm thick.
- .3 Electrical equipment mounting boards:
 - .1 Plywood, DFP or CSP (unless noted otherwise): sheathing grade, or PP standard sheathing grade, square edge minimum 16 mm thick.

3.4 INSTALLATION

- .1 Install members true to line, levels and elevations, square and plumb.
- .2 Construct continuous members from pieces of longest practical length.
- .3 Install spanning members with "crown-edge" up.
- .4 Select exposed framing for appearance. Install lumber and panel materials so that grade-marks and other defacing marks are concealed.
- .5 Install wall sheathing in accordance with manufacturer's printed instructions.
- .6 Install roof sheathing in accordance with requirements of NBC.
- .7 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding electrical equipment mounting boards, and other work as required.
- .8 Install furring to support siding applied vertically where there is no blocking and where sheathing is not suitable for direct nailing.
 - .1 Align and plumb faces of furring and blocking to tolerance of 1:600.
- .9 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.
- .10 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized or steel fasteners.
- .11 Install sleepers as indicated.
- .12 Use dust collectors and high quality respirator masks when cutting or sanding wood panels.
- .13 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

- .14 Countersink bolts where necessary to provide clearance for other work.
- .15 Use nailing disks for soft sheathing as recommended by sheathing manufacturer.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 - Waste Managing and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by rough carpentry installation.

Part 1 General

1.1 SECTION INCLUDES

- .1 Roof curbs.
- .2 Blocking in wall openings.
- .3 Wood furring and grounds.
- .4 Telephone and electrical panel back boards.
- .5 Concealed wood blocking for support of toilet and bath accessories.
- .6 Preservative treatment of wood.

1.2 RELATED SECTIONS

- .1 Section 03 30 00 - Cast-in-Place Concrete: Concrete openings to receive wood blocking.
- .2 Section 08 11 13 - Metal Doors and Frames: Door openings to receive wood blocking.
- .3 Section 08 51 13 - Aluminum Windows: Window openings to receive wood blocking.

1.3 REFERENCES

- .1 CAN/CSA O80 Series 08 Wood Preservation
- .2 CSA-O121-08 - Douglas Fir Plywood.
- .3 CSA-O151-09 - Canadian Softwood Plywood.
- .4 CSA-O153-M1980 (R2008) - Poplar Plywood.
- .5 NPA A208.1-2009 - Particleboard.
- .6 CANPLY (Canadian Plywood Association) - Canadian Plywood Handbook.

1.4 QUALITY ASSURANCE

- .1 Lumber Products: Graded and stamped to NLGA requirements.
- .2 Plywood Products: Certified and graded to CANPLY requirements.

1.5 DELIVERY, STORAGE, AND PROTECTION

- .1 Protect materials from warping or other distortion by stacking in vertical position.

Part 2 Products

2.1 MATERIALS

- .1 Lumber: NLGA (Standard Grading Rules for Canadian Lumber).

- .1 CAN/CSA-O141, softwood SPF species, grade 2.
- .2 19% maximum moisture content, pressure preservative treatment where noted.
- .2 Plywood: .
 - .1 DFP., Grade CANPLY, to CSA O121.
 - .1 Good One Side (G1S), tongue and groove edges.
 - .2 CSP, Grade CANPLY Grade SHG unsanded, exterior use, thickness as indicated, urea-formaldehyde free.
 - .1 General use and equipment mounting boards: Sheathing (SHG).
 - .2 Exterior use: Sheathing (SHG), exterior grade, thickness as indicated.
 - .3 Pressure preservative treatment: to CSA O80.9, plywood to CSA O151 and graded as specified.

2.2 ACCESSORIES

- .1 Fasteners: Hot dipped galvanized steel for high humidity and treated wood locations, unfinished steel elsewhere.
- .2 Anchors: Toggle bolt type for anchorage to hollow masonry. Expansion shield and lag bolt type for anchorage to solid masonry or concrete. Bolt fastener for anchorages to steel..

2.3 FACTORY WOOD TREATMENT

- .1 Wood Preservative (Pressure Treatment): CSA-O80 Series using water borne preservative with 0.25% retainage.

Part 3 Execution

3.1 FRAMING

- .1 Set members level and plumb, in correct position.
- .2 Place horizontal members, crown side up.
- .3 Construct curb members of single pieces.
- .4 Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.
- .5 Coordinate curb installation with installation of roofing vapour retardant and decking and support of deck openings.

3.2 SHEATHING

- .1 Secure sheathing to framing members with ends over firm bearing and staggered.

- .2 Install telephone and electrical panel back boards with plywood sheathing material where required. Size the back board by 100 mm (4 inches) beyond size of electrical panel.

3.3 SITE APPLIED WOOD TREATMENT

- .1 Apply preservative treatment in accordance with manufacturer's written instructions.
- .2 Brush apply one (1) coat of preservative treatment on wood in contact with cementitious materials. Treat site-sawn cuts.
- .3 Allow preservative to dry prior to erecting members.

3.4 SCHEDULES

- .1 Telephone and Electrical Panel Boards: 19 mm (3/4 inch) thick, square edges, site brush applied preservative treated.
- .2 Other elements as noted on drawings.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Structural floor, wall, and roof framing.
- .2 Floor, wall, and roof sheathing.
- .3 Sill gaskets.
- .4 Miscellaneous framing and sheathing.

1.2 RELATED SECTIONS

- .1 Section 03 30 00 - Cast-in-Place Concrete: Setting anchors in masonry.
- .2 Section 08 11 13 - Metal Doors and Frames: Door openings to receive wood blocking.
- .3 Section 08 51 13 - Aluminum Windows: Window openings to receive wood blocking.

1.3 REFERENCES

- .1 CANPLY (Canadian Plywood Association) - Canadian Plywood Handbook.
- .2 CSA-O121-08 (R2013) - Douglas Fir Plywood.
- .3 CSA-O151-09 - Canadian Softwood Plywood.
- .4 CSA-O325-07 (R2012) - Construction Sheathing.
- .5 APA (The Engineered Wood Association) - Product Guide Grades and Specifications.
- .6 NLGA (National Lumber Grades Authority) - Standard Grading Rules for Canadian Lumber, 2010 edition.

1.4 QUALITY ASSURANCE

- .1 Perform Work in accordance with the following agencies:
 - .1 Lumber Grading Agency: Certified by NLGA.
 - .2 Plywood Grading Agency: Certified by CANPLY.

1.5 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.
- .2 Protect materials from warping or other distortion by stacking in vertical position.

Part 2 Products

2.1 LUMBER MATERIALS

- .1 Lumber Grading Rules: NLGA.

2.2 SHEATHING MATERIALS

- .1 Plywood Roof Sheathing: CSA-O121, Rated Sheathing, Span Rating 40/20; Exposure Durability 1; unsanded.
- .2 Plywood Wall Sheathing: CSA-O121, Rated Sheathing, Span Rating 40/20; Exposure Durability 1; unsanded.

2.3 ACCESSORIES

- .1 Fasteners and Anchors:
 - .1 Screws and Nails: Galvanized steel; type and size suitable for application.
- .2 Sill Gasket (top of foundation wall): 6 mm thick, plate width as indicated, closed cell polyethylene foam.
- .3 Sill Flashing:
 - .1 Flexible Flashing: Self-adhesive, rubberized-asphalt compound, bonded to high-density, polyethylene film, minimum thickness 30.

Part 3 Execution

3.1 FRAMING

- .1 Set structural members level and plumb, in correct position.
- .2 Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- .3 Place horizontal members, crown side up.
- .4 Construct load bearing framing and curb members full length without splices.
- .5 Double members at openings over INSERT VALUE mm wide. Space short studs over and under opening to stud spacing.
- .6 Construct double joist headers at floor and ceiling openings and under wall stud partitions that are parallel to floor joists. Frame rigidly into joists.
- .7 Bridge joists in excess of 2.3 m span as detailed. Fit solid bridging at ends of members.
- .8 Place full width continuous sill flashings under framed walls on cementitious foundations. Lap flashing joint 100 mm.
- .9 Place sill gasket directly on sill flashing. Puncture gasket clean and fit tight to protruding foundation anchor bolts.
- .10 Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.
- .11 Coordinate curb installation with installation of decking and support of deck openings.

3.2 SHEATHING

- .1 Secure roof sheathing with longer edge perpendicular to framing members and with ends staggered and sheet ends over bearing.
- .2 Use sheathing clips between sheets between roof framing members.
- .3 Secure wall sheathing with long dimension parallel to wall studs, with ends over firm bearing and staggered.
- .4 Install plywood to simple span.

3.3 ERECTION TOLERANCES

- .1 Section 01 73 00: Tolerances.
- .2 Framing Members: 6 mm from true position, maximum.
- .3 Surface Flatness of Floor: 2 mm in 1 m maximum, and 13 mm in 9 m maximum.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 06 10 00 - Rough Carpentry.
- .3 Section 06 18 00 - Glued-Laminated Construction.

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA O80 Series-08(R2012), Wood Preservation.
 - .2 CSA O86 Consolidation-09, Engineering Design in Wood.
 - .3 CSA O141-05(R2009), Softwood Lumber.
 - .4 CSA S307-M1980(R2001), Load Test Procedure for Wood Roof Trusses for Houses and Small Buildings.
 - .5 CSA S347-14, Method of Test for Evaluation of Truss Plates Used in Lumber Joints.
 - .6 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel.
- .2 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber 2014.
- .3 National Research Council (NRC)/Institute for Research in Construction (IRC) - Canadian Construction Materials Centre (CCMC)
 - .1 CCMC-on-line edition, Registry of Product Evaluations.
- .4 Truss Plate Institute of Canada (TPIC)
 - .1 TPIC - 2011, Truss Design Procedures and Specifications for Light Metal Plate Connected Wood Trusses.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wood trusses and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Nova Scotia, Canada.
 - .2 Include on drawings:
 - .1 Each shop and erection drawing submission showing connection details.
 - .2 Indicate special structural application and specification as according to local authorities having jurisdiction.
 - .3 Indicate TPIC Truss Design Procedure and CSA O86 Engineering Design in Wood and specific CCMC Product Registry number of the truss plates
 - .4 Indicate species, sizes, and stress grades of lumber used as truss members. Show pitch, span, camber, configuration and spacing of trusses. Indicate connector types, thicknesses, sizes, locations and design value. Show bearing details. Indicate design load for members.
 - .5 Submit stress diagram or print-out of computer design indicating design load for truss members. Indicate allowable load and stress increase.
 - .6 Do load testing on representative trusses selected by Departmental Representative. Provide certification that trusses meet requirements of CSA S307 and CSA S347.
 - .7 Indicate arrangement of webs or other members to accommodate ducts and other specialties.
 - .8 Show location of lateral bracing for compression members.
 - .9 Test reports: submit certified test reports for prefabricated wood trusses from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.

- .10 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .11 Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Fabricator for trusses to show evidence of quality control program such as provided by regional wood truss associations, or equivalent.
 - .2 Fabricator for welded steel connections to be certified in accordance with CSA W47.1.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wood trusses from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
 - .4 Provide bearing supports and bracings. Prevent bending, warping and overturning of trusses.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

- .1 Design light metal plate connected wood trusses in accordance with TPIC truss design procedures for wood truss chords and webs in accordance with engineering properties in CSA O86.
- .2 Design light metal plate connected wood trusses in accordance with TPIC truss design procedures for truss joint designs to test engineering properties in accordance with CSA S347 and listed in CCMC Registry of Product Evaluations.
- .3 Design trusses, bracing and bridging in accordance with CSA O86.1 for loads as indicated on drawings and for building locality as ascertained by NBC, Climatic Information for Building Design in Canada and minimum uniform and minimum concentrated loadings stipulated in NBC commentary.
- .4 Limit live load deflection to 1/360th of span.
- .5 Limit total dead and live load deflections to 1/240th of span unless otherwise specified or indicated.
- .6 Provide camber for trusses as indicated.

2.2 MATERIALS

- .1 Lumber: Douglas Fir Larch or Hem-Fir species, select structural grade, softwood, S4S, with maximum moisture content of 19% at time of fabrication and to following standards:
 - .1 CSA O141.
 - .2 NLGA (National Lumber Grading Association), Standard Grading Rules for Canadian Lumber.
- .2 Fastenings: to CSA O86.
- .3 Preservative: as indicated on drawings.

2.3 FABRICATION

- .1 Fabricate wood trusses in accordance with approved shop drawings.
- .2 Provide for design camber and roof slopes when positioning truss members.
- .3 Connect members using bolts and nuts metal gussets, metal connector plates, split rings or shear plates, as required.
- .4 Apply preservative in accordance with CAN/CSA O80 Series, as indicated on drawings.

2.4 SOURCE QUALITY CONTROL

- .1 Identify lumber by grade stamp of an agency certified by Canadian Lumber Standards Administration Board.
- .2 Certify by agency accredited by Standards Council of Canada that preservative treated wood in accordance with CAN/CSA O80 Series.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for product installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.3 ERECTION

- .1 Erect wood trusses as indicated and in accordance with approved shop drawings.
- .2 Handling, installation, erection, bracing and lifting in accordance with manufacturers' instructions.
- .3 Make adequate provisions for handling and erection stresses.
- .4 Exercise care to prevent out-of-plane bending of trusses.
- .5 Install temporary horizontal and cross bracing to hold trusses plumb and in safe condition until permanent bracing and decking are installed.
- .6 Install permanent bracing in accordance with approved shop drawings, prior to application of loads to trusses.
- .7 Do not cut or remove any truss material without approval of Departmental Representative.
- .8 Remove chemical and other surface deposits on treated wood, in preparation for applied finishes.

3.4 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its products, and submit written reports, in acceptable format, to verify compliance of work with Contract.

- .2 Manufacturer's field services: provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.
- .2 Schedule site visits to review work at stages listed:
 - .1 After delivery and storage of products, and when preparatory work on which work of this Section depends is complete, but before installation begins.
 - .2 Minimum twice during progress of work at 25% and 60% complete.
 - .3 Upon completion of work, after cleaning is carried out.
- .3 Obtain reports within three days of review and submit immediately to Departmental Representative.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 - Waste Managing and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Division 01 - General Requirements.
- .2 Section 06 10 00 - Rough Carpentry.
- .3 Section 06 17 53 - Shop - Fabricated Wood Trusses.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A 36/A 36M-12, Standard Specification for Carbon Structural Steel.
 - .2 ASTM A 47/A 47M-99(2014), Standard Specification for Ferritic Malleable Iron Castings.
 - .3 ASTM A 123/A 123M-13, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .4 ASTM A 307-12, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .5 ASTM A 653/A 653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 CSA International
 - .1 CSA B111-1974(R2003), Wire Nails, Spikes and Staples.
 - .2 CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .3 CSA O86 Consolidation-09, Engineering Design in Wood.
 - .4 CSA O112.10-08(R2013), Evaluation of Adhesives for Structural Wood Products (Limited Moisture Exposure).
 - .5 CAN/CSA-O122-06(R2011), Structural Glued-Laminated Timber.
 - .6 CSA O177-06(R2011), Qualification Code for Manufacturer's of Structural Glued-Laminated Timber.
 - .7 CSA S16-09, Design of Steel Structures.

- .8 CSA W47.1-09, Certification of Companies for Fusion Welding of Steel Structures.
- .9 CAN/CSA-Z809-08, Sustainable Forest Management.
- .3 Green Seal Environmental Standards (GS)
 - .1 GS-11-11, Paints and Coatings.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.
 - .2 MPI #79 Primer, Alkyd, Anti-Corrosive for Metal.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting minimum 1 week prior to beginning, with key to:
 - .2 Verify project requirements.
 - .3 Review installation and substrate conditions.
 - .4 Co-ordination with other building subtrades.
 - .5 Review manufacturer's written installation instructions and warranty requirements.
- .2 Hold project meetings every month.
- .3 Ensure key personnel attend.
- .4 Departmental Representative will provide written notification of change to meeting schedule established upon contract award minimum 24 hours prior to scheduled meeting.
- .5 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for glued-laminated construction and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit electronic copies of WHMIS MSDS.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Nova Scotia, Canada.
 - .2 Submit erection drawings in accordance with CSA S16 and CSA O86.
 - .3 Shop drawings for members: indicate stress grade, service grade and appearance grades, shop applied finishes, camber, cuts, ledgers, holes and connection details.
- .4 Samples:
 - .1 Submit for review and acceptance of each unit.
 - .2 Samples will be returned for inclusion into work.
 - .3 Submit 2 samples of connector plates.
- .5 Certifications: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .1 Submit manufacturer's plant certification to CSA O177, Appendix B at completion of fabrication.
- .6 Test and Evaluation Reports: submit certified test reports for members glued-laminated from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
- .7 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.
- .8 Manufacturers Reports:
 - .1 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in Part 3 - FIELD QUALITY CONTROL.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacture structural glued-laminated members in plant certified by CSA as meeting requirements of CSA O177.
 - .2 Submit certificate in accordance with CSA O177, Appendix B at completion of fabrication.
 - .3 Fabricator for welded steel connections to be certified to CSA W47.1.
 - .4 Place authorization labels on glued-laminated members indicating manufactured in CSA certified plant.
 - .5 Certification of material protective sealer.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .2 Apply protective sealer to glued-laminated units before shipping unless specified otherwise.
 - .3 Wrap members prior to leaving plant with a moisture resistant wrapping.
 - .4 Use padded, non-marring slings for handling glued-laminated members.
 - .5 Protect corners with wood blocking.
 - .6 Make adequate provision for delivery and handling stresses.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Slit underside of membrane covering during storage at site without defacing member.
 - .3 Store glued-laminated units and protect from weather, block off ground and separate with stripping, so air may circulate around faces of members.

- .4 Cover glued-laminated units with opaque moisture resistant membrane if stored outside.
- .5 Store and protect glue-laminated products from nicks, scratches, and blemishes.
- .6 Replace defective or damaged materials with new.
- .4 Packaging Waste Management:
 - .1 Ensure preservative treated wood is disposed of by means other than for recycling or reuse.
 - .2 Dispose of treated wood, end pieces, wood scraps and sawdust at sanitary landfill approved by Departmental Representative.
 - .3 Dispose of unused wood preservative material at official hazardous material collections site approved by Departmental Representative.
 - .4 Divert unused wood materials from landfill to recycling reuse composting facility approved by Departmental Representative.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Laminating stock: Douglas Fir-Larch or Hem to CAN/CSA-O122.
 - .1 CAN/CSA-Z809.
- .2 Adhesive: to CSA O112.10, to grade of service required in accordance with CAN/CSA-O122.
 - .1 Urea-formaldehyde free.
- .3 Sealer for glued-laminated members: penetrating type, clear, non-yellowing liquid.
- .4 Fastenings:
 - .1 Split ring connections: hot rolled carbon steel, SAE 1010, in accordance with SAE handbook.
 - .2 Shear plate connections:
 - .3 Pressed steel type: hot rolled carbon steel, SAE 1010, in accordance with SAE handbook.
 - .4 Malleable iron type: to ASTM A 47/A 47M, grade 350.

- .5 Lag screws: ASTM A307.
- .6 Bolts: to ASTM A 307.
- .7 Side plates: to CSA G40.20/G40.21.
- .8 Drift pins: to ASTM A 307.
- .9 Glued-laminated rivets: hot dip galvanized to CSA G40.20/G40.21. Nails and spikes: to CSA B111.
- .10 Truss plates: light gauge galvanized sheet steel to ASTM A 653, grade SS, minimum yield point 255 MPa.
- .5 Shop coat primer for steel connections: to MPI #18, for items not required to be galvanized.
- .6 Galvanizing: to ASTM A 123/A 123M, hot dipped, minimum zinc coating of 610 g/m², for items exposed to exterior conditions.

2.2 FABRICATION

- .1 Fabricate members to following classifications:
 - .1 Stress grade: to CSA O86.
 - .1 Beams primarily loaded in bending: 24F-EX bending grade.
 - .2 Columns primarily loaded in compression: 16C-E compression grade.
 - .3 Members primarily loaded in tension: 18F-E tension grade.
 - .2 Service grade: interior.
 - .3 Appearance grade: to minimum commercial appearance grade, unless indicated otherwise.
- .2 Mark laminated members for identification during erection. Marks not to be visible in final assembly.
- .3 Do not apply sealer to areas which are to receive stained finish or preservative treatment.
- .4 Design connections to CSA O86, and CSA S16 unless specifically detailed, to resist shears, moments and forces indicated.
- .5 Fabricate in accordance with CSA S16.
- .6 Galvanize connections after fabrication, for exterior application, otherwise, prime in shop.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for glue-laminated material installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 ERECTION

- .1 Protect protective sealer from damage before erection.
 - .1 Touch up damaged areas on site with specified sealer.
- .2 Erect glued-laminated members as indicated and in accordance with approved erection drawings.
- .3 Brace and anchor members until permanently secured by structure.
- .4 Make adequate provisions for erection stresses.
- .5 Splice and join only at locations as indicated on approved erection drawings.
- .6 Do not field cut or alter members without Departmental Representative's approval. If approved, preservative treat cut ends.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, protecting and cleaning of product.
 - .2 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Ensure manufacturer's representative is present before and during critical periods of installation and testing.
- .2 Schedule site visits:
 - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Minimum twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of the Work, after cleaning is carried out.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 - Waste Managing and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by glue laminated construction installation.

PART 1 GENERAL

1.1 SCOPE OF WORK

Includes but is not necessarily confined to the supply and installation of the following carpentry and related work.

- .1 Interior trim and woodwork.
- .2 Wood or composite wood.
- .3 Plywood and MDF board wall paneling.
- .4 Wood sills.
- .5 On-site fabricated millwork and finished wood items including related Hardware.
- .6 Shop fabricated paneling and cabinet work is included in Section 06 40 00.

1.2 RELATED WORK

- | | | |
|----|--|------------------|
| .1 | Construction Waste Management & Disposal | Section 01 74 00 |
| .3 | Carpentry | Section 06 10 00 |
| .4 | Architectural Cabinetwork | Section 06 40 11 |
| .5 | Joint Sealants | Section 07 92 00 |
| .6 | Wood Flush Doors | Section 08 14 16 |
| .7 | Hardware | Section 08 71 00 |
| .8 | Painting | Section 09 91 10 |

1.3 QUALITY ASSURANCE

- .1 Work in this Section shall at least conform to the specified Grades of Work and Sections of the latest edition of the AWI / AWMAC Quality Standards Illustrated.
- .2 Fabricate all components of this Section in conformance with AWI / AWMAC Quality Standards Illustrated custom grade.
- .3 All site fabricated casework shall be to the standards of Section 06 40 00.
- .4 Moisture content for interior woodwork shall be not more than 12%.

1.4 ENVIRONMENTAL CRITERIA

- .1 Green Alternatives: trades and suppliers are encouraged to suggest sustainable products as alternatives to those specified for the consideration of the Departmental Representative. In all cases the contractor shall obtain written approval from the tendering authority prior to bidding an alternative product.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Submittals specification Section 01 33 00.

- .2 Clearly indicate details of construction, critical dimensions, species, grade, profiles, jointing, fastening, quantities and location, hardware and other related details.
- .3 Be responsible for obtaining all on-site measurements required for fitting components to the building.

1.6 SAMPLES

- .1 When requested by the Departmental Representative, submit 300 mm square samples of the panelling and its finish.
- .2 When requested, provide a 300 mm lineal sample of wood trim, and its finishes.

1.7 DELIVERY AND STORAGE

- .1 Make no delivery until site conditions are adequate to receive the work of this section. Protect materials from weather while in transit to site.
- .2 Store and install materials indoors, in well ventilated areas with a constant but minimum temperature of 16 degree C. and maximum moisture content of 12% when measured with a moisture meter.

2.0 MATERIALS

- .1 Softwood Lumber - to CSA 0141 and AWI / AWMAC grading standards, maximum 12% moisture content, Custom Grade.
- .2 Solid Wood Trims and Exposed Framing - to CSA 0141 and AWI / AWMAC grading standards, max. 12% moisture content, Premium Grade No. 1 Maple, unless specifically noted otherwise.
- .3 Western Softwood, Plywood - to CSA 0151, good two sides, good one side, select sheathing as required, rotary cut, D2 grade or better.
- .4 Hardwood Plywood - to CSA O115, good two sides, good one side as required, rotary cut. If species is not indicated on drawings all exposed plywood shall be "Birch", natural B2 grade or better, uniform white one side, whole piece face. Thickness as indicated on drawings.
- .5 Nails, Spikes and Staples - to CSA B111, hot dip galvanized for damp interior locations, plain finish elsewhere. Screws in MDF shall be parallel core type.
- .6 Glues - all glue shall be low V.O.C., waterproof and of best quality for intended use.
- .7 Clear Finish - shall be three (3) coats water-based polyurethane where specified

to standards of Section 09 91 10.

3.0 EXECUTION

3.1 WORKMANSHIP GENERAL

- .1 All work shall conform to the Nova Scotia Building Code, C.S.A. Standards and these specifications.
- .2 All work shall be strong, neat, accurately fitted and finished in keeping with the best trade practices.
- .3 Where not returned, inside corners shall be coped or housed. Outside corners shall be edge mitred and returned to avoid exposed end grain.
- .4 All wood trims, frames and similar materials shall be neatly fitted and nailed with well set finishing nails.
- .5 All finish woodwork coming in contact with concrete shall receive a prime coat of paint on contacting surfaces prior to installation.
- .6 Recommendations for Waste Management
 - .1 Separate wood waste in accordance with the Waste Management Plan.
 - .2 Separate the following categories for salvage or reuse n site:
 - .1 Sheet materials larger than 0.1858 m².
 - .2 Solid wood: trim longer than 400mm, multiple offcuts of any size larger than 300".
 - .3 Recycle the following categories:
 - .1 Clean, unpainted dimensional lumber.
 - .4 Separate the following categories for disposal and place in designated areas for hazardous materials.
 - .1 Treated, stained, painted, or contaminated wood.

3.2 WOOD FINISHES AND TRIMS

- .1 Supply and install wood finishes and trims of profile, dimensions and in locations shown on the drawings.
- .2 Trims to be glued and nailed with well set finishing nails.
- .3 Trims to be accurately and neatly fitted, all boards and trims with butt joints and at corners to be mitred at 45 degrees.

- .4 MDF panels shall be installed with asymmetrical screws, pre-drilled holes.

3.3 ON-SITE FABRICATED MILLWORK

- .1 Supply and install on-site fabricated millwork to standards of Section 06 40 00.

3.4 FLUSH PANELLING – VENEER PLYWOOD PANELS WHERE SPECIFIED

- .1 Install wood panelling to AWMAC Custom Grade.
- .2 Panels shall be glued to the substrate.
- .3 Nails shall be kept to a minimum and where used, shall be of minimum size and spacing. Set nails neatly before filling.
- .4 Nail holes to be filled with matching filler by the painting trade.
- .5 After installation, the exposed surfaces shall be sanded with a minimum of 100 grit sandpaper so that no cross scratches, knife, or other manufacturing marks are visible in normal light conditions.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

- .1 The work of this section comprises the furnishing of all labour, materials and equipment required for the supply and installation of all Architectural Casework as shown on the drawings and herein specified.
- .2 The work covered by this section includes but is not necessarily confined to the following:
 - .1 Counters and cupboards.
 - .2 Adjustable shelving.
 - .3 Hardware to casework.
 - .4 Miscellaneous Metals - metal fabrications and metal brackets, braces and legs built into casework, where indicated on the Millwork details.
 - .5 Glass and glazing in millwork where applicable.
- .3 It is intended that casework be factory modular units for installation at site. Ends of each individual modular millwork unit, whether exposed or not shall be finished to allow for possible future relocation. Consult architect for clarification where required.

1.2 RELATED WORK ELSEWHERE

- | | | |
|----|---|------------------|
| .1 | Miscellaneous metal works | Section 05 50 00 |
| .2 | Rough Carpentry | Section 06 10 00 |
| .3 | Glass and glazing | Section 08 80 50 |
| .4 | Metal Stud Systems | Section 09 22 16 |
| .5 | Standards for painted finishes applied in shop | Section 09 91 10 |
| .6 | Whiteboards & Tackboards | Section 10 11 00 |
| .7 | Plumbing Fixtures in cabinets | Division 25 |
| .8 | Electrical Outlets and Light Fixtures in millwork | Division 26 |

1.3 QUALITY ASSURANCE

- .1 Standards: Millwork shall at least conform to the "Quality Standards for Architectural Woodwork" of the "Architectural Woodwork Manufacturers of Canada" (A.W.M.A.C.), latest edition. These specifications take precedence over A.W.M.A.C. standards.
- .2 Grade: Construct all cabinet work to A.W.M.A.C. custom grade.
- .3 All casework to be shop-fabricated.
- .4 Firm (woodwork manufacturer) with no less than 5 years of production experience similar to a specific project, whose qualifications indicate the ability to comply with the requirements of this Section.
- .5 The woodwork manufacturer must have at least one project in the past 5 years where the value of the woodwork was within 20 percent of the cost of woodwork for this Project.

- .6 Single Source Responsibility: A single manufacturer shall provide and install the work of described in this Section.

1.4 DESIGN

- .1 Design Millwork to withstand edge load of 100kg per lineal meter of counter.
- .2 All perimeter counters to be wall hung.
- .3 Style: Flush overlay construction for door and drawer faces shall be used.
- .4 Cabinet Bodies: including gables, fixed shelves, bottoms, minimum 19 mm nominal thickness, birch veneer plywood or approved alternate.
- .5 Counter-tops: solid surface material, minimum 19 mm nominal thickness, smooth finish. Glue and mechanically fasten all seems, including 40mm nosing. Radius all exposed edges and corners. See architectural drawings for details.
- .6 Backs: minimum 6 mm nominal thickness plywood, or melamine on minimum 12 mm nominal thickness medium density fibreboard core, where concealed.
- .7 Doors: shall be minimum 19 mm nominal thickness , birch veneer to medium density fiberboard (MDF) core. Maximum cabinet door size shall be 610mm (24") in width and 2032mm (6'-8") in height.
- .8 Drawer sides, backs, and subfronts: minimum 12 mm nominal thickness, clear solid fir or hardwood veneer core plywood.
- .9 Drawer fronts: minimum 19 mm nominal thickness to match cabinet bodies.
- .10 Drawer bottoms: minimum 6 mm nominal thickness, hardwood veneer fibre core plywood.
- .11 Shelves: minimum 19 mm nominal thickness up to 813 mm in length and minimum 25 mm nominal thickness up to 1200 mm in length, veneer core plywood. All adjustable shelves shall be seismically restrained by the use of notches and surface-mounted standards.
- .12 Finishes:
- .1 Exposed Surfaces
- .1 Cabinet bodies, tops of cupboards, and all other exposed surfaces shall be finished uniform in grain and colour with Uniform White B-2 face birch, book-matched veneer, with solid 6 mm hardwood or 3 mm PVC edging; clear-coat finish.
- .2 Semi-Exposed Surfaces
- .1 Cabinet interiors shall be birch veneer to match casework.
- .2 Drawer interiors shall be polyurethane finished plywood or solid wood.
- .3 Concealed Surfaces: no finish required.

- .13 Factory Finishing: All products provided in this Section shall be factory finished using Architectural Woodwork Standards finish system. Finish shall be AWS Custom Grade.

1.5 INSPECTION

- .1 Architectural woodwork shall be manufactured and/or installed to A.W.M.A.C. Quality Standards Premium. Shop drawings shall be submitted for review or approval before any work is commenced. Where it is deemed necessary by the Department Representative, a sample cabinet (consisting of a minimum of 1 drawer, 1 door, showing precisely the materials, hardware and the type of construction the manufacturer intends to use) shall be submitted for inspection. Proposed substitutions in materials or hardware must be detailed in writing and approved by the Department Representative before submission of shop drawings.
- .2 **The Contractor shall provide and pay for an A.W.M.A.C. inspection.**

1.6 GUARANTEE

- .1 This contractor shall provide an A.W.M.A.C. Guarantee Certificate as to labour, materials, and workmanship for a period of two (2) years after the date of the Department Representative's Certificate of Substantial Completion.

1.7 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with General Conditions.
- .2 Clearly indicate details of construction, critical dimensions, profiles, jointing, fastening, quantities and location of hardware and other related details.
- .3 Be responsible for obtaining all on-site measurements required for fitting units to the building.

1.8 SAMPLES

- .1 When requested by the Department Representative submit 300 mm square samples of the panelling and its finish
- .2 Contractor shall fabricate a full-size sample of counter incorporating drawers, doors and typical finishes and hardware for approval by Department Representative prior to commencing work on total project. Sample may be a unit to be incorporated into project.

1.9 DELIVERY AND STORAGE

- .1 Make no delivery until site conditions are adequate to receive the work of this section. Protect materials from weather while in transit to site.
- .2 Store and install materials indoors, in well ventilated areas with a constant but minimum temperature of 16°C. and maximum moisture content of 12% when measured with a moisture meter.

- .3 Deliver millwork units to room or location of final installation.

1.10 ENVIRONMENTAL CRITERIA

- .1 Green Alternatives: trades and suppliers are encouraged to suggest sustainable products as alternatives to those specified for the consideration of the Department Representative. In all cases the contractor shall obtain written approval from the tendering authority prior to bidding an alternative product.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Softwood Lumber: to CSA O141, and AWI / AWMAC grading standards, maximum 10% moisture content, QSI Lumber Grade II, for hidden framing members. Locally supplied. FSC Certified where available.
- .2 Hardwood Lumber: to CSA O141 and AWI / AWMAC grading standards maximum 6% moisture content. For exposed and semi-exposed surfaces, QSI Grade I Birch, to match hardwood plywood, unless otherwise indicated on drawings. Locally supplied. FSC Certified where available.
- .3 Hardwood Plywood: to CSA 0.115-1967, 19mm C2 Whole Piece Face, (C2WPF) 7-ply NOVA #2SSG OS HPVA HP-1, FSC Certified
 - .1 For exposed surfaces: Grade AA, Rotary-cut, book matched uniform White Birch.
 - .2 For semi-exposed surfaces: Grade A, Rotary-cut book-matched White Birch.
 - .3 For concealed surfaces: Grade B, Rotary-cut Birch.
- .4 Core Materials:
 - .1 Medium density particle board (MDF): "Medite II", formaldehyde free, or approved alternative for casework gables and doors only.
 - .2 Plywood: shall be used for all countertops and shelves.
 - .1 Western Softwood Plywood: to CSA O151, good two sides, good one side, select sheathing as required, rotary cut, D2 grade or better.
 - .2 Douglas Fir Plywood: to CSA O121, Exterior Grade, good two sides, good one side or medium density overlaid as required, rotary cut, D2 grade or better.
- .5 Veneer core plywood - shall be a non-telegraphing hardwood manufactured with exterior glue.
- .6 Hardboard: high density to CGSB 11-GP-3 Type 1, 3 mm thick unless shown otherwise. Smooth finish to exposed sides. "Masonite" or equal.

- .7 Solid Surface Counter tops: where indicated on drawings or details, counter tops, VOC-free, solid, monolithic, and non-porous panel made from 100% post-consumer recycled paper that has been saturated with petro-free phenolic resins and natural pigments, pressed and fused together into a solid panel. Smooth finish. Paneltech Products Inc. "Paperstone", distributed by SIP Distribution Eastern Canada, Tel: 416-879-8833. "EcoStone", distributed by Richelieu and "Greenstone", manufactured by Duron, are pre-approved alternates.
- .8 Edge Banding: shall be 6 mm solid birch to clear finish veneer case work and 3 mm PVC to plastic laminate finish case work or approved equal in colour finish to match plastic laminate colours, to all laminate finished casework and cabinets and exposed shelving, unless otherwise noted.
- .9 Glues: all glue shall be low V.O.C. waterproof of best quality for intended purpose.
 - .1 Interior Woodwork and Millwork: Low-VOC, FS MMM-A-125C, Type IKI, water-and-mold-resistant. Use ASTM D3110, dry-use type for laminated and finger-jointed members, certified in accordance with ASTM C557 and complying with required VOC regulations.
 - a. Water-based contact cement
 - b. Water-based construction adhesive.
 - .2 Exterior Millwork: ANSI / HPMA HP 1983, Type I, air-cure waterproof type. Use ASTM D3110, wet-use type for laminated and finger-jointed members.
- .10 Cabinet Hardware: to CGSB 69-GP-8M.
 - .1 Finish to all cabinet hardware chrome plate (C15) unless indicated otherwise.
 - .2 The trade names specified are standard of acceptance. Alternates to be approved. Provide samples if requested, samples will be returned.
 - .3 Adjustable Shelf Supports: to CGSB 69-GP-8a B21210 (surface-mounted) K & V 255, or Roll-It 00120BZ, 2 per shelf end unless indicated otherwise.
 - .4 Shelf Rests: to CGSB 69-GP-8M. K & V 239 or Roll-It 00106BZ, (Roll-It 005875 for glass shelves) 4 per shelf plus 10% spare.
 - .5 Door and Drawer Pulls: Flush integrated pulls unless otherwise noted. If pulls are required in select locations: Richelieu 255, Satin Chrome (175) finish.
 - .6 Drawer Slides to CGSB 69-GP-8a, one pair per drawer, 45 kg. (100 lb.), Accuride ball-bearing full extension series 3832, or approved equal.
 - .7 Cabinet Hinges: Hager 1821, Mepla SS73-253 Z100, or Hettich "Selecta 6 T22" (1 003 854).
 - .8 Coat Hooks: Kitchener Forging #209 zinc-plated coat hook, or equivalent.

- .9 Cabinet Lock: with full size high quality cylinder; lock must Be able to be master keyed for single-key operation as required; Brass 6 pin tumbler keyed to 444 444; minimum 10 year warranty; flush-mount design appropriate for 19mm door and drawer fronts (or as specified); 25 mm throw; solid brass cylinder with satin chrome plate finish. **Flush installation required.**
- .10 Elbow Catches: Ives 2B4 or Richelieu #5540-130, magnetic on details; cast Brass; top and bottom for pairs of doors with locks.
- .11 Roller Catches:
- .1 for Large Doors:
- .1 Richelieu BP55292G
.2 Amerock 9745
.3 Ives equivalent, if any
- .2 for Small Doors:
- .1 Richelieu BP6032G
.2 Ives 330
.3 Amerock 143
- .12 Towel Rack: 450 mm chrome rail to one door of sink units in kitchens, and where specifically indicated on drawings.
- .13 Legs and Frames where shown on details, shall be 32 x 32 mm chrome tube with 5 mm x 75 x 75 steel top plates with 4 screws to cabinet frame, unless indicated otherwise. Adjustable glides shall be EIF RP 181 with R182 inserts or equal with a nail tip insert to provide fastening through flooring. Finishes shall be chrome, powder coat enameled as indicated on the drawings to standards of Section 09 90 00.
- .14 "Grommets" - for wiring through desks. Richelieu #A 60.0910-90, 72 mm diameter, PVC purpose made. Colour: black.
- .15 Label Holders - Hager 4368 = 9.5 x 63.5 mm chrome finished wrought brass.
- .11 Finish: 3 coats Low V.O.C. clear coat where specified, to standards of Section 09 90 00. All miscellaneous metal work in this section to receive powder coat enamel finish.
- .12 Mounting Screws and screws to join units: purpose made to receive P.V.C. snap on caps, colour to match laminate, or chrome round head Robinsons.

2.2 FABRICATION

- .1 Make reference to interior elevations, floor plans and other Architectural drawings for supplementary information required for construction of casework including additional lock locations, non-standard lengths and custom units.

- .2 Where clearances to walls or other equipment interfere with the intended use of moving parts (i.e. doors and drawers) notify Department Representative prior to fabrication to receive clarification.
- .3 Cabinet drawer and door fronts to be flush.
- .4 All edges shall have 3 mm PVC edging to match plastic laminate surface of panels where applicable, or 6 mm hardwood edging to match face veneer.
- .5 Crossmembers, rails and kicks shall be minimum 19 mm nominal thickness, plywood or dimension lumber. Medium density fibreboard (MDF) is not permitted.
- .6 All counters and cupboards including laminate tops shall be completely fabricated in shop.
- .7 Set all nails and screws, apply coloured filler to indentations and finish, so that no fasteners or holes are visible in finished unit.
- .8 Screws used in MDF panelling shall be parallel core in predrilled holes. Units are to suit modular dimensions as shown on millwork details. Adjoining units shall be joined with four (4) cadmium plated 6 mm bolts.
- .9 Shop apply plastic laminate finishes to units as detailed, by full glue and pressure contact system. Adhere plastic laminate over entire surface. Make hairline joints when necessary. Use full sized laminate sheets to eliminate joints. Make joints only where approved. Slightly bevel edges.
- .10 Drawers shall be finished in shop with two (2) coats of clear polyurethane.
- .11 Clear finished plywood millwork indicated shall receive three (3) coats of polyurethane.
- .12 All fabricated metal brackets, legs, etc. shall be built to standards of Section 05 50 00 Miscellaneous Metals and painted to standards of finishes outlined in Section 09 90 00 - Painting.
- .13 Counter tops shall be fabricated in the longest lengths possible.
- .14 Caulk all interior corners in sink/basin units.

PART 3 EXECUTION

- .1 When necessary to cut and fit on the job, make material with ample allowance for cutting. Site cutting only permitted upon written consent of the Department Representative.
- .2 Adequately protect finished surfaces during delivery, handling and storage. Use proper handling equipment to prevent damage.
- .3 Provide heavy duty screw attachments for wall mounted cabinets to withstand minimum 120 kilograms/metre (81 lbs./ft.) total loading.
- .4 All finish woodwork coming in contact with concrete, cut-outs for sinks, drains, etc., to receive a prime coat of paint on contacting surfaces before erecting.

- .5 Where units with doors abut a wall, provide a 38 mm wide filler between millwork unit and wall, finish to match millwork unit, to allow doors to open a full 90°. Extent top of unit to suit filler.
- .6 Erect all millwork rigid, plumb and square.
- .7 All freestanding millwork shall be securely bolted to the floor to prevent overturning by seismic or other forces.

PART 4 SCHEDULE OF ITEMS

- .1 Numbers on plans refer to Millwork items detailed on Architectural Drawings.
- .2 Check all Architectural drawings for additional Architectural casework items.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Self adhesive, elastomeric sheet membrane waterproofing.
- .2 Protective board.

1.2 RELATED SECTIONS

- .1 Section 03 30 00 – Cast-In-Place Concrete: Concrete substrate.
- .2 Section 07 21 13 - Board Insulation: Perimeter and horizontal insulation protective cover.
- .3 Section 07 92 00 - Joint Sealants.

1.3 REFERENCES

- .1 ASTM D6134-07(2013) - Standard Specification for Vulcanized Rubber Sheets Used in Waterproofing Systems.

1.4 SYSTEM DESCRIPTION

- .1 Waterproofing System: Capable of resisting water head of INSERT VALUE mm and preventing moisture migration to interior.

1.5 PERFORMANCE REQUIREMENTS

- .1 Moisture Leakage Allowed: zero.
- .2 Seismic Loads: Design and size components to withstand seismic loads and sway displacement as calculated in accordance with applicable code.

1.6 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination:
 - .1 Coordinate the Work of this section and directly related sections, with installation of surrounding opening.

1.7 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data for surface conditioner, flexible flashings, joint cover sheet, and joint and crack sealants, with temperature range for application of waterproofing membrane.

1.8 QUALITY ASSURANCE

- .1 Perform Work in accordance with NRCA Waterproofing Manual.

- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.
- .3 Applicator Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.

1.9 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.

1.10 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 26: Environmental conditions affecting products on site.
- .2 Maintain ambient temperatures above 5 degrees C for twenty-four (24) hours before and during application and until liquid or mastic accessories have cured.

1.11 WARRANTY

- .1 Section 01 78 10: Warranties.
- .2 For warranty repair work, remove and replace materials concealing waterproofing.

Part 2 Products

2.1 MANUFACTURERS

- .1 Henry; Product: Blueskin WP 100 Basic.
- .2 Other acceptable manufacturers offering functionally equivalent products.
 - .1 W.R Meadows; Product: MEL-ROL.
 - .2 Soprema; Product: COLPHENE 3000.
- .3 Substitutions: Refer to Section 01 62 00.

2.2 ADHESIVE MATERIALS

- .1 Adhesives: As recommended by membrane manufacturer.
- .2 Thinner and Cleaner: As recommended by adhesive manufacturer, compatible with sheet membrane.

2.3 ACCESSORIES

- .1 Sealant: 07 92 00.
- .2 Protection Board: Board Insulation specified in Section 07 21 13.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verification of existing conditions before starting work.
- .2 Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of waterproofing system.
- .3 Verify items which penetrate surfaces to receive waterproofing are securely installed.

3.2 PREPARATION

- .1 Protect adjacent surfaces not designated to receive waterproofing.
- .2 Clean and prepare surfaces to receive waterproofing in accordance with manufacturer's written instructions.
- .3 Do not apply waterproofing to surfaces unacceptable to manufacturer.
- .4 Seal cracks and joints with sealant materials using depth to width ratio as recommended by sealant manufacturer.
- .5 Apply surface conditioner at a rate recommended by manufacturer. Protect conditioner from rain or frost until dry.

3.3 INSTALLATION - SELF ADHERED

- .1 Install membrane waterproofing to manufacturer's instructions.
- .2 Roll out membrane. Minimize wrinkles and bubbles.
- .3 Remove release paper layer. Roll out on substrate with a mechanical roller to encourage full contact bond.
- .4 Lap sides and ends to membrane manufacturer's written instructions.
- .5 Overlap edges and ends and seal by heat sealing minimum 75 mm. Seal permanently waterproof. Apply uniform bead of sealant to joint edge.
- .6 Reinforce membrane with multiple thickness of membrane material over joints, whether joints are static or dynamic.
- .7 Weather lap joints on sloped substrate in direction of drainage. Seal joints and seams. Coordinate with drain installation, Section 22 42 01.
- .8 Install flexible flashings. Seal watertight to membrane.
- .9 Seal membrane and flashings to adjoining surfaces.
- .10 Extend membrane over cants and up intersecting surfaces at membrane perimeter minimum 150 mm above horizontal surface for first ply and INSERT VALUE mm at subsequent plies laid in shingle fashion.
- .11 Seal items protruding to or penetrating through membrane and install counter flashing membrane material.

3.4 INSTALLATION - PROTECTION BOARD

- .1 Place protection board directly against membrane; butt joints.
- .2 Adhere protection board to substrate with mastic. Scribe and cut boards around projections, penetrations, and interruptions.

3.5 PROTECTION OF FINISHED WORK

- .1 Section 01 78 40: Protecting installed work.
- .2 Do not permit traffic over unprotected or uncovered membrane.

3.6 SCHEDULES

- .1 Foundation Wall Waterproofing: Apply waterproof membrane from top of foundation walls to bottom of strip footing.
- .2 Cistern Exterior Wall Waterproofing: Apply waterproof membrane from top of foundation walls to bottom of strip footing.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Board insulation required at wall construction and underside of floor slabs.

1.2 RELATED SECTIONS

- .1 Section 07 21 16 - Blanket Insulation.
- .2 Section 07 26 23 - Subgrade Membrane: Gas Barrier: Board Insulation below slab
- .3 Section 07 44 53 - Glass-Fibre Reinforced Cementitious Panels: Board insulation behind wall cladding.
- .4 Section 07 61 00 - Sheet Metal Roofing: Board insulation behind metal roof cladding.
- .5 Section 07 55 11 - SBS APP Modified Bitumen - Protected Membrane Roofing: Board insulation at roof system.

1.3 REFERENCES

- .1 ASTM C578-10a - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- .2 ASTM E96/E96M-10 - Standard Test Methods for Water Vapor Transmission of Materials.
- .3 CAN/ULC-S102-10 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .4 CAN/ULC-S701-11 - Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .5 CAN/ULC-S702-09 - Standard for Mineral Fibre Thermal Insulation for Buildings.
- .6 CAN/ULC S706-09 - Standard for Wood Fibre Insulating Boards for Buildings.

1.4 SYSTEM DESCRIPTION

- .1 Materials of This Section: Provide thermal protection to vapour retarder in conjunction with vapour retarder materials in Section 07 26 00.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the work with Section 07 26 00 for installation of vapour retarder and Section 07 27 00 for air seal materials.

1.6 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data on product characteristics, performance criteria, limitations, as required..

1.7 CLOSEOUT SUBMITTALS

1.8 MOCK-UP

- .1 Section 01 43 00: Requirements for mock-up.
- .2 Provide mock-up of materials of this section and wall cladding materials of Sections 07 43 53.
- .3 Locate where directed by Consultant.
- .4 Approved mock-up may remain as part of the Work.

1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 26: Environmental conditions affecting products on site.
- .2 Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

Part 2 Products

2.1 INSULATION MATERIALS

- .1 Extruded Polystyrene Insulation (XPS): to CAN/ULC-S701, Type 4; cellular type, conforming to the following:
 - .1 Compressive Strength: high density 275 kPa (40 psi).
 - .2 Thermal Resistance: as indicated on drawings.
 - .3 Board Thickness: as indicated on drawings.
 - .4 Board Edges: Square.
- .2 Polyisocyanurate Insulation (Unfaced): CAN/ULC S-704 and CAN/ULC S704-11, Type II and III, Class III, closed cell type, conforming to the following:
 - .1 Thermal Resistance: Aged per drawings.
 - .2 Board Thickness: per drawings.
 - .3 Board Edges: Square.
 - .4 Flame/Smoke Properties: to CAN/ULC-S102.

2.2 ADHESIVE MATERIALS

- .1 Adhesive : Type recommended by insulation manufacturer for application.

2.3 ACCESSORIES

- .1 Sheet Vapour Retarder: Specified in Section 07 26 00.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that substrate, adjacent materials, and insulation boards are dry and ready to receive insulation and adhesive.
- .3 Verify substrate surface is flat, free of irregularities.

3.2 INSTALLATION - FOUNDATION PERIMETER

- .1 Apply manufacture recommended adhesive in three (3) continuous beads per board length.
- .2 Install boards on foundation wall perimeter, vertically.
 - .1 Place boards in a method to maximize contact bedding.
 - .2 Stagger side joints.
 - .3 Butt edges and ends tight to adjacent board and to protrusions.
- .3 Extend boards over expansion joints and control joints, unbonded to foundation wall on one (1) side of joint.
- .4 Cut and fit insulation tight to protrusions or interruptions to the insulation plane.
- .5 Immediately following application of board insulation, place protective boards over exposed insulation surfaces. Apply manufacturer recommended adhesive in five (5) continuous beads per board length.
 - .1 Install boards vertically from base of foundation to top of insulation.
 - .2 Butt board joints tight; stagger from insulation joints.

3.3 INSTALLATION - EXTERIOR WALLS

- .1 Apply continuous 6 mm (1/4 inch) beads of adhesive in a grid pattern to prevent potential air movement behind the insulation boards. Apply adhesive fully around protrusions.
- .2 Install insulation boards over vapour barrier membrane starting at base of wall.
- .3 Place boards in a method to maximize contact bedding. Stagger end joints. Butt edges and ends tight to adjacent board and to protrusions.
- .4 Cut and fit insulation tight to protrusions or interruptions to the insulation plane.

3.4 INSTALLATION - UNDER CONCRETE SLABS

- .1 Place insulation under slabs on grade after base for slab has been compacted.
- .2 Cut and fit insulation tight to protrusions or interruptions to the insulation plane.
- .3 Prevent insulation from being displaced or damaged while placing concrete slab.

3.5 PROTECTION OF FINISHED WORK

- .1 Section 01 78 40: Protecting installed work.
- .2 Do not permit work to be damaged prior to covering insulation.

3.6 SCHEDULES

- .1 Exterior Wall Insulation: Polyisocyanurate Type I; set with adhesive.
- .2 Sloped Roof Insulation: Polyisocyanurate Type II; see Section 07 61 00.
- .3 Flat Roof Insulation: Polyisocyanurate Type III; see Section 07 52 11.
- .4 Foundation Wall Insulation: XPS insulation, High density, Type IV; set with adhesive.
- .5 Underslab Insulation: XPS insulation, High density, Type IV.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Batt insulation and vapour retarder in exterior wall and wall construction.

1.2 RELATED SECTIONS

- .1 Section 07 21 13 - Board Insulation.
- .2 Section 07 26 00 - Vapour Retarders: Vapour retarder materials to adjacent insulation.
- .3 Section 07 27 13 - Air/Vapour Barriers: AVB materials to adjacent insulation.
- .4 Section 07 84 00 - Firestopping.

1.3 REFERENCES

- .1 ASTM C665-06 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- .2 ASTM E84-10b - Standard Test Method for Surface Burning Characteristics of Building Materials.
- .3 CAN/ULC-S102-10 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .4 CAN/ULC-S702-09 - Standard for Mineral Fibre Thermal Insulation for Buildings.
- .5 UL 723-2008 - Tests for Surface Burning Characteristics of Building Materials (10th Edition).

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the work with Section 07 26 00 for installation of vapour retarder and Section 07 27 13 for air seal materials.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data on product characteristics, performance criteria, limitations..

1.6 SUBMITTALS FOR INFORMATION

- .1 Section 01 33 00: Submission procedures.

- .2 Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

Part 2 Products

2.1 MATERIALS

- .1 Insulation: CAN/ULC-S702 and ASTM C665, preformed glass fibre, in batt form; friction fit conforming to the following:
 - .1 Thermal Resistance: as noted or illustrated on drawings.
 - .2 Facing: Unfaced.
 - .3 Flame/Smoke Properties: glass fibre insulation to CAN/ULC-S102.
- .2 Insulation Fasteners: Steel impale spindle and clip on flat metal base, self adhering backing, length to suit insulation thickness, capable of securely and rigidly fastening insulation in place.
- .3 Wire Mesh: Galvanized steel, hexagonal wire mesh.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that substrate, adjacent materials, and insulation are dry and ready to receive insulation.

3.2 INSTALLATION

- .1 Install insulation to manufacturer's written instructions.
- .2 Install in exterior walls spaces without gaps or voids. Do not compress insulation.
- .3 Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- .4 Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within the plane of insulation.
- .5 Staple or nail facing flanges in place at maximum <Insert Value> on centre
- .6 Coordinate work of this section with construction of air/vapour barrier seal specified in Section 07 27 13.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Foamed-in-place insulation at exterior wall crevices requiring a thermal seal.
- .2 Foamed-in-place insulation at junctions of dissimilar wall and roof materials to achieve a thermal and air seal with protective cover.

1.2 RELATED SECTIONS

- .1 Section 07 21 13 - Board Insulation: Materials continuing the thermal barrier layer.
- .2 Section 07 26 00 - Vapour Retarders: Materials continuing the vapour seal.
- .3 Section 07 27 00 - Air Barriers: Materials continuing the air barrier seal.
- .4 Section 07 55 11 - SBS APP Modified Bitumen - Protected Membrane Roofing: Roof insulation.
- .5 Section 07 61 00 - Sheet Metal Roofing- Protected Membrane Roofing. Roof insulation.

1.3 REFERENCES

- .1 CAN/ULC-S102-10 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .2 CAN/ULC-S705.1-01 - Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Material - Specification (including Amendment 3).
- .3 CAN/ULC-S705.2-05 - Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Application.
- .4 CUFCA (The Canadian Urethane Foam Contractors Association).

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate work to ensure timely placement of insulation within construction spaces.
- .3 Pre-installation Meetings: Convene one (1) week before starting work of this section.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.

- .2 Product Data: Provide product description, insulation properties, preparation requirements and details.

1.6 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.
- .2 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience, and licensed and certified by the SPF Quality Assurance Program used by CUFCA.

1.7 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for flame and smoke requirements.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 26: Environmental conditions affecting products on site.
- .2 Do not install insulation when ambient temperature is lower than 21 degrees C.

Part 2 Products

2.1 MATERIALS

- .1 Insulation: Spray-applied rigid cellular polyurethane:
 - .1 Compressive Strength (at yield or 10 % deformation): 170 kPa.
 - .2 Water Vapor Permeability, max, 4.4 ng/Pa·s·m.
 - .3 Water Absorption, maximum): 5%.
 - .4 Tensile Strength (minimum), 200 kPa.
 - .5 Closed cell content (minimum): 90%.
 - .6 Flame Spread (maximum): 500.
- .2 Insulation: CAN/ULC-S705.1, spray-applied rigid cellular polyurethane insulation, medium density.

2.2 ACCESSORIES

- .1 Primer: As required by insulation manufacturer.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify work within construction spaces or crevices is complete prior to insulation application.

3.2 PREPARATION

- .1 Mask and protect adjacent surfaces from over spray or dusting.
- .2 Apply primer in accordance with manufacturer's written instructions.

3.3 INSTALLATION

- .1 Apply insulation to CAN/ULC-S705.2 and manufacturer's written instructions.
- .2 Apply insulation by spray method, to a uniform monolithic density without voids.
- .3 Patch damaged areas.

3.4 PROTECTION OF FINISHED WORK

- .1 Section 01 78 40: Protecting installed work.
- .2 Do not permit subsequent construction work to disturb applied insulation.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Sheet and sealant materials for controlling vapour diffusion.

1.2 RELATED SECTIONS

- .1 Section 03 30 00 - Cast-in-Place Concrete: under slab vapour retarder.
- .2 Section 07 21 13 - Board Insulation: Insulation and vapour retarder.
- .3 Section 07 27 00 - Air Barriers: An air barrier as an integral part of a complete curtain wall assembly.
- .4 Section 07 92 00 - Joint Sealants: Sealants.
- .5 Section 08 11 13 - Standard Hollow Metal Frames: Door frames.
- .6 Section 08 51 13 - Aluminum Windows: Window frames.

1.3 REFERENCES

- .1 ASTM C920-11 - Standard Specification for Elastomeric Joint Sealants.
- .2 ASTM C1311-10 - Standard Specification for Solvent Release Sealants.
- .3 ASTM E96/E96M-13 - Standard Test Methods for Water Vapor Transmission of Materials.
- .4 CGSB-19-GP-14M-1984 - Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.
- .5 CAN/CGSB-19.13-M87 - Sealing Compound, One-component, Elastomeric, Chemical Curing.
- .6 CAN/CGSB-51.34-M86 - Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.
- .7 SWRI (Sealant, Waterproofing and Restoration Institute) - Sealant and Caulking Guide Specification.

1.4 DEFINITION

- .1 Vapour Retarder: A material or assembly of materials that resists water vapour diffusion through it.

1.5 SYSTEM DESCRIPTION

- .1 Materials and installation methods to provide continuity of vapour retarder:
 - .1 In conjunction with materials described in Section 07 21 13 and 07 21 16.
 - .2 To seal gaps between enclosure components and opening frames.
 - .3 To seal at concrete slab on grade openings..

1.6 PERFORMANCE REQUIREMENTS

- .1 Vapour Permeability (Perm): Maximum water vapour permeance of 57.4 ng/(Pa•s•sq m) measured to CAN/CGSB-51.34.

1.7 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination: Coordinate with other work having a direct bearing on work of this section.
- .3 Pre-installation Meetings: Convene one (1) week before starting work of this section.
- .4 Sequencing:
 - .1 Sequence Work to permit installation of materials in conjunction with other retardant materials and seals and air barrier assemblies.
 - .2 Do not install vapour retarder until items penetrating it are in place.

1.8 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data indicating material characteristics, performance criteria, limitations, perm rating.

1.9 QUALITY ASSURANCE

- .1 Perform Work in accordance with SWRI - Sealant and Caulking Guide Specification requirements for materials. Maintain one (1) copy of each document on site.

Part 2 Products

2.1 SHEET MATERIALS

- .1 Sheet Retarder Type 1: CAN/CGSB-51.34, clear polyethylene film for above grade and below grade application, 0.25 mm thick; a perm rating of <1.

2.2 SEALANTS

- .1 Butyl Sealant Type A: CGSB-19-GP-14M; butyl rubber base, single component, solvent release, non-skinning; colour black:
 - .1 Elongation Capability: 5%.
 - .2 Service Temperature Range: -40 to 82 degrees C.
 - .3 Shore A Hardness Range: 10 to 30.
- .2 Primer: Recommended by sealant manufacturer to suit application.
- .3 Cleaner: Non-corrosive type; recommended by sealant manufacturer; compatible with adjacent materials.

2.3 ADHESIVES

- .1 Mastic Adhesive Type 1: asphalt type, compatible with sheet barrier and substrate, thick mastic of uniform consistency.
- .2 Adhesive Type 2: Compatible with sheet barrier and substrate, permanently non-curing.

2.4 ACCESSORIES

- .1 Thinner and Cleaner for Butyl Sheet: As recommended by sheet material manufacturer.
- .2 Tape: Polyethylene self-adhering type, mesh reinforced, 50 mm wide, compatible with sheet material.
- .3 Electrical Vapour Barrier Box: Rigid, moulded polyethylene box with reinforced flanges.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify condition of substrate and adjacent materials.

3.2 PREPARATION

- .1 Remove loose or foreign matter which might impair adhesion.
- .2 Clean and prime substrate surfaces to receive adhesive in accordance with manufacturers' written instructions.

3.3 INSTALLATION

- .1 Install materials to manufacturer's written instructions.
- .2 Vapour Retarder For Solid Substrate: Secure sheet barrier Type 1 to solid construction with adhesive. Lap edges and ends 150 mm and adhesive seal to ensure complete and continuous seal.
- .3 Vapour Retarder For Stud Framed Walls: Secure sheet barrier Type 1 to stud faces with adhesive. Lap edges over stud faces, lap ends onto adjacent construction; caulk ends with Type A sealant to ensure complete seal.
- .4 Vapour Retarder For Wall/Roof Junction: Lap sheet barrier Type 1 from wall retarder onto roof vapour retarder continuously. Seal edges and ends with adhesive. Caulk with Type A sealant to ensure complete seal. Position laps over firm bearing.
- .5 Vapour Retarder Seal For Openings: Install sheet barrier Type 1 between window frames and adjacent vapour retarder and seal with sealant. Caulk with Type A sealant to ensure complete seal. Position laps over firm bearing.

- .6 Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges or where compatibility with adjacent materials may be in doubt.
- .7 Vapour Barrier Box: Install vapour barrier boxes at electric outlet and switch locations on exterior walls. Lap and seal perimeter with sheet barrier.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Loose laid membrane with adhesive sealed joints.
- .2 Radon gas collector, vent piping above plane of roof.

1.2 RELATED SECTIONS

- .1 Section 31 23 33.01 - Backfilling.
- .2 Section 03 30 00 - Cast-in-Place Concrete: Concrete substrate.
- .3 Section 07 26 00 - Vapour Retarders: Sheet barrier for resisting the water vapour diffusion through wall or roof constructed assembly.
- .4 Section 07 27 13 - Air Barriers: An air barrier as an integral part of a wall or roof constructed assembly.
- .5 Section 07 21 13 - Board Insulation: Perimeter and horizontal insulation protective cover.
- .6 Section 07 62 00 - Sheet Metal Flashing and Trim: Metal counter flashings.
- .7 Section 07 92 00 - Joint Sealants.

1.3 REFERENCES

- .1 ASTM D882-10 - Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
- .2 ASTM D1004-09 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
- .3 ASTM E96/E96M-10 - Standard Test Methods for Water Vapor Transmission of Materials.
- .4 ASTM E1745-09 - Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

1.4 PERFORMANCE REQUIREMENTS

- .1 Sealed Sheet Membrane and Vent Stack Assembly:
 - .1 Capable of containing and venting Radon gas to exterior via collector and sealed pipe stack above roof.
 - .2 Seal joints and unintended tears or perforations of the membrane air tight.
 - .3 Seal pipe and joints in the vent stack, airtight.
- .2 Membrane: Capable of preventing moisture migration to interior.

1.5 SUBMITTALS FOR REVIEW

- .1 Product Data: Provide data for flexible flashings, joint seals, and crack sealants, with temperature range for application of membrane.

1.6 CLOSEOUT SUBMITTALS

1.7 QUALITY ASSURANCE

- .1 Perform Work in accordance with: Manufacturer's instructions .
- .2 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Maintain ambient temperatures above 5 degrees C for twenty-four (24) hours before and during application and until liquid or mastic accessories have cured.

Part 2 Products

2.1 MATERIALS

- .1 Gas and moisture Barrier Membrane: multi-layer low density polyethylene (LDPE), one (1) layer of reinforcing mesh.
- .2 Accessories:
 - .1 PVC "Top Hat" pipe collars to seal penetrations through surrounding floor and roof construction.
 - .2 PVC Vent pipe cap.
 - .3 Tape Seal: Self adhesive, 30 mm wide.
 - .4 Circular Clamps: Stainless steel band, threaded adjustable clamp.
- .3 Adhesives, Thinner and Cleaner: As recommended by membrane manufacturer, compatible with sheet membrane.
- .4 Sealant: same type as used for joint seal tape.
- .5 Counter Flashings: bituminous type, as specified in Section 07 62 00.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify substrate surfaces are durable; free of matter detrimental to adhesion or application of membrane and related components.

3.2 PREPARATION

- .1 Protect adjacent surfaces not designated to receive protection.
- .2 Clean and prepare surfaces to receive membrane in accordance with manufacturer's written instructions.
- .3 Do not apply membrane or related components to surfaces unacceptable to manufacturer.
- .4 Seal cracks and joints with sealant materials using depth to width ratio as recommended by sealant manufacturer.

3.3 INSTALLATION - SUMP AND VENT STACK

- .1 Place stack piping.
 - .1 Seal joints and penetrations through building construction air tight.
 - .2 Place top-hat and other accessories at floor and roof construction.
 - .3 Seal spaces between pipe and surrounding construction.
- .2 Place sump where indicated.
 - .1 Place vent stack fitting in one port.
 - .2 Connect to stack piping.
 - .3 Seal three other ports.

3.4 INSTALLATION - MEMBRANE

- .1 Install membrane and accessories to manufacturer's written instructions.
- .2 Roll out membrane. Minimize wrinkles and bubbles.
- .3 Overlap edges, ends, and joints minimum 150 mm and seal by contact sealant tape.
- .4 Seal joints and protrusions, permanently air tight and waterproof.
- .5 Reinforce membrane with multiple thicknesses of membrane material over static or moving joints.
- .6 Weather lap joints on sloped substrate in direction of drainage. Seal joints and seams.
- .7 Install flexible flashings and accessories.
 - .1 Seal watertight to membrane.
 - .2 Seal to adjoining surfaces.
- .8 Extend membrane over intersecting surfaces at membrane perimeter minimum 150 mm.
- .9 Seal items protruding or penetrating through membrane.
- .10 Install counter flashing membrane material.

3.5 PROTECTION OF FINISHED WORK

- .1 Do not permit traffic over unprotected or uncovered membrane.

- .2 Protect membrane from damage by adhering protection boards. Scribe and cut boards around projections and interruptions.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Air leakage criteria for primary air seal building enclosure materials and assemblies.
- .2 Materials and installation methods supplementing primary air seal materials and assemblies.
- .3 Air seal materials to connect and seal openings, joints, and junctions between other air seal materials and assemblies.

1.2 RELATED SECTIONS

- .1 Section 07 21 13 - Board Insulation: Insulation directly adjacent to the air seal.
- .2 Section 07 26 00 - Vapour Retarder: Coordinate vapour seal criteria with air barrier requirements.
- .3 Section 07 84 00 - Firestopping: Fire stopping materials.
- .4 Section 07 92 00 - Joint Sealants: Sealant materials and installation techniques.
- .5 Section 07 55 11 - SBS APP Modified Bitumen - Protected Membrane Roofing: Roofing membrane and vapour retarder.
- .6 Section 08 63 00 - Metal Framed Skylights.
- .7 Section 08 41 13 - Aluminum Framed Entrances And Storefronts: Aluminum entrances and store fronts, functioning as a primary air seal.

1.3 REFERENCES

- .1 ASTM C920-11 - Standard Specification for Elastomeric Joint Sealants.
- .2 ASTM C1311-10 - Standard Specification for Solvent Release Sealants.
- .3 ASTM E283-04(2012) - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .4 ASTM E330/E330M-14 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- .5 NABA (National Air Barrier Association) - Air Barrier Quality Assurance Program (QAP).
- .6 SWRI (Sealant, Waterproofing and Restoration Institute) - Sealant and Caulking Guide Specification.

1.4 DEFINITIONS

- .1 Air Barrier: A continuous network of materials and joints providing air tightness, with adequate strength and stiffness to not deflect excessively under air pressure differences, to which it will be subjected in service. It can be comprised of a single material or a combination of materials to achieve the performance requirements.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the work of this section with all sections referencing this section.
- .3 Pre-installation Meetings: Convene one (1) week before starting work of this section.
- .4 Sequencing: Sequence work to permit installation of materials in conjunction with related materials and seals.

1.6 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data on material characteristics, performance criteria, limitations, and manufacture's installation guidelines.

1.7 QUALITY ASSURANCE

- .1 Perform Work to SWRI - Sealant and Caulking Guide Specification requirements for materials.
- .2 Perform Work in accordance with the NABA Air Barrier Quality Assurance Program.
- .3 Contractor Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience .
- .4 Applicator Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience.

1.8 MOCK-UP

- .1 Section 01 43 00: Provide mock-up of air and air/vapour barrier system, which is comprised of a variety of materials.
- .2 Construct typical exterior wall panel, INSERT VALUE m long by INSERT VALUE m wide, incorporating window frame and sill, insulation, vapour retarder; illustrating materials interface and seals.
- .3 Locate where directed by Consultant.

- .4 Approved mock-up may remain as part of the Work.

1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 26: Environmental conditions affecting products on site.
- .2 Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

Part 2 Products

2.1 SHEET MATERIALS

- .1 Sheet Seal Type 1: Mechanically Fastened Wall Air Barrier. A spun plastic fibre, water resistant, breathable underlayment for rain screen wall systems.
 - .1 Product: AirOutshield Wall, manufactured by SRP Canada.
 - .2 Other acceptable manufacturers offering functionally equivalent products.
 - .1 Product: WallShield, Manufactured by VaproShield
 - .2 Product: Tyvek Commerical Wrap, Manufactured by Dupont.
- .2 Sheet Seal Type 2: Mechanically Fastened Roof Air Barrier. A spun plastic fibre, water resistant, breathable underlayment for roof systems.
 - .1 Product: AirOutshield Roof, manufactured by SRP Canada.
 - .2 Other acceptable manufacturers offering functionally equivalent products.
 - .1 Product: SlopeShield, Manufactured by VaproShield.
 - .2 Product: RoofLiner, Manufactured by Dupont.
- .3 Sheet Seal Type 3: Self Adhered Roof Eave Water Barrier. Self-adhesive rubberized asphalt bonded to sheet polyethylene, high temperature, nominal total thickness of INSERT VALUE mm.
 - .1 Product: Blueskin PE 200 HT, manufactured by Bakor.
 - .2 Other acceptable manufacturers offering functionally equivalent products.
 - .1 Product: Sopraseal Stick 1100 T, Manufactured by Soprema.
 - .2 Product: Ice & Water Shield HT. Manufactured by Grace.
- .4 Sheet Seal Type 4: Self Adhered Wall/Roof Air/Vapour Barrier. Self-adhesive rubberized asphalt bonded to sheet polyethylene, regular temperature, nominal total thickness of 40 mil.
 - .1 Product: Blueskin SA, manufactuted by Bakor.
 - .2 Other acceptable manufacturers offering functionally equivalent products.
 - .1 Product: Sopraseal Stick 1100 T, Manufactured by Soprema.
 - .2 Product: Perm-A-Barrier Wall Membrane, manufactured by Grace.
- .5 Sheet Seal Type 5: Self Adhered Thru-Wall Flashing. Self-adhesive rubberized asphalt bonded to sheet polyethylene, regular temperature, nominal total thickness of 40 mils.
 - .1 Product: Blueskin TWF, manufacturing by Bakor.

- .2 Other acceptable manufacturers offering functionally equivalent products.
 - .1 Product: Sopraseal WFM, Manufactured by Soprema.
 - .2 Product: Perm-A-Barrier Wall Flashing, Manufactured by Grace.

2.2 SEALANTS

- .1 Sealants: Refer to Sealants 07 92 00.
- .2 Primer: Recommended by sealant manufacturer.
- .3 Substrate Cleaner: Non-corrosive, type recommended by sealant manufacturer.

2.3 ADHESIVES

- .1 Mastic Adhesive Type 1: Bituminous mastic compatible with sheet seal and substrate, thick mastic of uniform knife grade consistency.

2.4 ACCESSORIES

- .1 Thinner and Cleaner for Butyl Sheet: As recommended by sheet material manufacturer.
- .2 Tape: UV resistant polypropylene, self adhering type, mesh reinforced, 50 mm wide, compatible with sheet material.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that surfaces and conditions are ready to accept the Work of this section.

3.2 PREPARATION

- .1 Remove loose or foreign matter which might impair adhesion of materials.
- .2 Clean and prime substrate surfaces to receive adhesive to manufacturers written instructions.

3.3 INSTALLATION

- .1 Install materials to manufacturer's written instructions.
- .2 Seal all wall and roof opening transitions and material transitions with adhesive Type 1 material.
- .3 Install steel sheet bridging over cracks and joints exceeding 6 mm; seal with sheet seal. Secure with flat head screws.
- .4 Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

3.4 PROTECTION OF FINISHED WORK

- .1 Section 01 78 40: Protecting installed work.

- .2 Do not permit adjacent work to damage work of this section.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 High Density Fibre Cement (HDFC) exterior wall cladding installed at walls and soffits.

1.2 RELATED SECTIONS

- .1 Section 06 10 13 - Wood Blocking and Curbing
- .2 Section 07 27 13 - Air and Air/Vapour Barriers
- .3 Section 09 22 16 - Metal Furring and Lath

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM)4
 - .1 ASTM A653/A653M-04a, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC S114-05, Standard Method of Test for Determination of Non-Combustibility in Building Materials.
 - .2 CAN/ULC-S134-92, Standard Method of Fire Test of Exterior Wall Assemblies.

1.4 QUALITY ASSURANCE

- .1 Manufacturer's Qualifications: Company specializing in manufacturing the Products specified in this section with minimum of seven (10) years of documented experience.
- .2 Installer's Qualifications: Company specializing in performing the work of this section with minimum of five (5) years of documented experience and certified by manufacturer. Certification stating that installer is experienced in the installation of the specified products, and who has completed installations similar in extent and design with a record of successful performance.

1.5 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data: Manufacturer's data sheet on each product to be used including:
 - .1 Preparation instructions and recommendations.
 - .2 Storage and handling requirements and recommendations.
 - .3 Installation methods.
 - .4 Fire Test ULC S114 - Classification "non combustible"

- .3 Shop Drawings: Submit shop drawings showing layout, profiles and product components, including anchorage, accessories, finish colors, patterns and textures
- .4 Samples: Submit duplicate samples of specified material.
- .5 Certificates: Submit certified test results from independent testing laboratory substantiating certifying compliance with CAN/ULC-S134 and CAN/ULC S114.

1.6 EXTRA STOCK MATERIALS

- .1 Provide 5% of each panel colour and finish specified.
- .2 Extra materials to be from same production run as installed materials.
- .3 Store where directed by Department Representative.

1.7 MOCK-UP

- .1 Section 01 43 00: Provide mock-up of cladding system, which is comprised of a transitions and accessories.
- .2 Construct typical exterior wall cladding assembly, approximately 100 sf in area, incorporating a wall opening and corner condition.
- .3 Located where directed by Department Representative.
- .4 Approved mock-up may remain as part of the Work.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials in manufacturer's original, unopened packaging, with labels clearly identifying product name and manufacturer.
- .2 Store in accordance with manufacturer's instructions, unopened until ready for installation. Store in a covered area, away from water, on a flat, level surface with adequate support to prevent sagging.
- .3 Protect materials during handling to prevent damage.

1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Product Acclimation:
 - .1 Components to be conditioned in occupancy temperature and humidity conditions for 4 days prior to installation.
 - .2 Remove components from packaging and stack flat with spacers between pieces for 4 days prior to installation.

1.10 WARRANTY

- .1 Provide 10 year extended warranty for failure to meet specifications. Provide coverage for failure of finish and panel integrity.

Part 2 Products

2.1 PRODUCT MANUFACTURES

- .1 Product: CEMBONIT, manufactured by Cembret.
- .2 Other acceptable manufacturers offering functionally equivalent products
 - .1 Product: NATURA, manufactured by Equatone.
 - .2 Product: CARAT, manufactured by Swisspearl.

2.2 CHARACTERISTICS

- .1 Finish: Selected from standard range.
- .2 Panel Thickness: min 8 mm
- .3 Mounting: Shiplap mounting with concealed fasteners as detailed.

2.3 ACCESSORIES

- .1 Fasteners: Stainless steel, with head and length as recommended by panel manufacturer. Self-drilling for wood supporting structure.
- .2 Insect Screens: Galvanized metal screening cloth; aperture size and gauge as selected by Department Representative.

Part 3 Execution

3.1 EXAMINATION

- .1 Do not begin installation until substrates have been properly prepared.
- .2 If substrate preparation is the responsibility of another installer, notify Department Representative of unsatisfactory preparation before proceeding.
- .3 Commencement of Work is acceptance of substrate conditions.

3.2 PREPARATION

- .1 All boxes to be opened and components removed from packaging and stacked flat with spacers in the final installed environment for a minimum 3-4 days prior to installation.
- .2 Prepare surfaces using the methods recommended by the manufacturer for the substrate under the project conditions.
- .3 Protect metal surfaces in contact with concrete, masonry mortar, plaster or other cementitious surface with isolation coating.
- .4 Pre-drill panels at fastener locations as recommended by manufacturer for size of fastener specified. Provide support at panel back when drilling.

3.3 INSTALLATION

- .1 Install in accordance with manufacturer's installation instructions.

- .2 Secure supporting structure to structural framing as indicated.
- .3 Maintain minimum ventilated airspace. A minimum gap of 8 mm (3/8 inch) between panels is required.
- .4 Install insect screening to locations indicated and as required to prevent insect penetration within assembly.

3.4 ERECTION TOLERANCES

- .1 Section 01 73 00: Tolerances.
- .2 Maximum Variation from Level or Plumb: 1.5 mm per m non-cumulative or 3mm in 3000 mm, whichever is less.

3.5 CLEANING

- .1 Section 01 74 00: Cleaning installed work.
- .2 In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
- .3 Repair or replace defaced or disfigured finishes caused by work of this section.

3.6 PROTECTION OF FINISHED WORK

- .1 Section 01 78 40: Protecting installed work.
- .2 Protect building surfaces against damage from roofing work.
- .3 Where traffic must continue over finished roof membrane, protect surfaces.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Sheathing over deck surface.
- .2 Vapour retarder.
- .3 Insulation.
- .4 Modified bituminous membrane roofing, flashings and membrane movement joints.

1.2 RELATED SECTIONS

- .1 Section 03 30 00 - Cast-in-place Concrete
- .2 Section 06 10 13 - Wood Blocking and Curbing: cant strips and Wood nailers.
- .3 Section 07 62 00 - Sheet Metal Flashing and Trim: Weather protection for base flashings.
- .4 Section 07 92 00 - Joint Sealants.
- .5 Division 22 – Plumbing: Roof drains.

1.3 REFERENCES

- .1 CAN/CSA-A123.4-04 (R2008) - Asphalt for Constructing Built-Up Roof Coverings and Waterproofing Systems.
- .2 CSA-O151-09 - Canadian Softwood Plywood.
- .3 CGSB 37-GP-9Ma-83 - Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
- .4 CGSB 37-GP-56M-85 - Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.
- .5 CAN/ULC-S107-10 - Methods of Fire Tests of Roof Coverings.
- .6 CAN/ULC-S701-11 - Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .7 CAN/ULC S706-09 - Standard for Wood Fibre Insulating Boards for Buildings.
- .8 FM (Factory Mutual) - Roof Assembly Classifications.
- .9 Province of Nova Scotia Roofing Contractors Association – Roofing Specifications Manual.
- .10 CRCA (Canadian Roofing Contractors' Association) – CRCA Roofing Specifications Manual.
- .11 ULC - Building Materials Directory.

1.4 SYSTEM DESCRIPTION

- .1 Assembly and installation of components include two (2) ply membrane system, bitumen adhered, with granulated surface, vapour retarder insulation and protection board.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the work with the installation of associated metal flashings, as the work of this section proceeds.
- .2 Pre-installation Meetings: .
 - .1 Convene one (1) week before starting work of this section.
 - .2 Review preparation and installation procedures and coordinating and scheduling required with related work.

1.6 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Shop Drawings: Indicate setting plan for tapered insulation, layout of seams, direction of laps, base flashing details.
- .3 Product Data: Provide product data for membrane, flashing materials, vapour retarder, insulation, protective coating, and accessories..

1.7 CLOSEOUT SUBMITTALS

1.8 QUALITY ASSURANCE

- .1 Perform Work to manufacturer's written instructions. Maintain one (1) copy of each document on site.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum twenty (20) years documented experience.
- .3 Installer Qualifications: Company specializing in performing the work of this section with minimum ten (10) years documented experience and approved by the manufacturer.

1.9 REGULATORY REQUIREMENTS

- .1 FM: Roof Assembly Classification, Class 1 Construction, wind uplift requirement of 1-90, to FM 1-28 "Design Wind Loads".

1.10 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver products in manufacturer's original containers, dry, undamaged, seals and labels intact.

- .2 Store products in weather protected environment, clear of ground and moisture.
- .3 Stand roll materials on end.

1.11 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 26: Environmental conditions affecting products on site.
- .2 Do not apply roofing membrane during inclement weather or when ambient temperatures are below manufacturers' written recommendations.
- .3 Do not apply roofing membrane to damp or frozen deck surface.
- .4 Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

1.12 WARRANTY

- .1 Section 01 78 10: Warranties.
- .2 Contractor's Warranty: Provide two (2) year warranty on roofing, dated from time of Substantial Performance.
- .3 Manufacturer's Warranty: Provide a ten (10) year (non pro-rated) manufacturer's warranty (in the name of the client) to include coverage for failure to meet specified requirements, including damage resulting from failure to prevent penetration of water. The warranty shall include all necessary labour and materials to repair the roof system.

Part 2 Products

2.1 MANUFACTURERS - MEMBRANE MATERIALS

- .1 Henry
- .2 Other acceptable manufacturers offering functionally and aesthetically equivalent products.
 - .1 Soprema
 - .2 IKO
 - .3 Tremco
 - .4 Firestone
- .3 Substitutions: Refer to Section 01 62 00.

2.2 MEMBRANE MATERIAL

- .1 Membrane: CAN/CGSB-37-GP-56M, asphalt and polymer modifiers of styrene-butadiene-styrene (SBS) prefabricated sheet. .
 - .1 Base Sheet Membrane: non-woven polyester reinforcement, nominal thickness 2.2 mm.
 - .1 Application: Fully adhered:
 - .2 Both sides thermofusible plastic film.

- .2 Base Sheet Flashing: non-woven polyester reinforcement, nominal thickness 3 mm.
 - .1 Application: fully adhered:
 - .2 Both sides thermofusible plastic film.
- .3 Cap Sheet Membrane: non-woven polyester reinforcement and elastomeric bitumen SBS, nominal thickness 6 mm.
 - .1 Application: Fully adhered
 - .2 Top surface granule surfaced.
 - .3 Underside thermofusible plastic film.
- .4 Cap Sheet Flashing: non-woven polyester reinforcement and elastomeric bitumen SBS, nominal thickness 6 mm.
 - .1 Application: fully adhered:
 - .2 Top surface granule surfaced.
 - .3 Underside thermofusible plastic film.
- .5 Perimeter Strip Membrane: self-adhesive elastomeric bitumen membrane with non-woven polyester reinforcement reinforcement.

2.3 BITUMEN MATERIALS

- .1 Asphalt: to CSA A123.4, Type III.
- .2 Asphalt Primer: CGSB-37-GP-9Ma.
- .3 Plastic Cement: CAN/CGSB-37.5, cutback asphalt type.
- .4 Adhesive: Membrane and flashing adhesive recommended by manufacturer.

2.4 VAPOUR RETARDER

- .1 Modified Bitumen Membrane: To CGSB-37-GP-56M, reinforced with fibreglass mat, 90 g/sq m. top surface woven polyethylene, underside silicone film.

2.5 INSULATION

- .1 Insulation: CAN/ULC-S704 Type 1, Class 3, Polyisocyanurate rigid board, both faces finished with glass reinforced mat , with the following characteristics:
 - .1 Board Density: 2 kg /m3.
 - .2 Board Size: 1220 x 2440 flat; 1220 x 1220 tapered.
 - .3 Thermal Resistance: R5.7 LTTR per inch.
 - .4 Board Edges: Square.

2.6 OVERLAY BOARD

- .1 Glass/Mineral Fibre Board: CAN/ULC-S702, 25 mm thick; ship lapped, asphalt impregnated.

2.7 FLASHINGS

- .1 Flexible Flashings: Same material as membrane; black colour.

- .2 Counter Flashings: prefinished metal, specified in Section 07 62 00.
- .3 Control or Expansion Joint Flashing: Sheet butyl, metal counter flashings and stainless steel materials, to CRCA construction details as required.

2.8 ACCESSORIES

- .1 Fibre Cant and Tapered Edge Strips: Asphalt impregnated wood fibreboard, preformed to configuration as detailed.
- .2 Fasteners: ASTM C1002, galvanized type, appropriate for purpose intended and approved by Factory Mutual and system manufacturer; length required for thickness of material with metal washers.
- .3 Sheathing Joint Tape: heat resistant type.
- .4 Sealants: as recommended by membrane manufacturer.
- .5 Strip Reglet Devices: galvanized; surface mounted, binder bars, maximum possible length per location, with attachment flanges.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that surfaces and site conditions are ready to receive work.
- .3 Verify deck is clean and smooth, free of depressions, waves, or projections.
- .4 Confirm dry deck by moisture meter with 12% moisture maximum.
- .5 Verify roof openings, curbs, pipes, conduit, sleeves, ducts, and vents through roof are solidly set, and wood cant strips are in place.

3.2 PREPARATION - CONCRETE DECK

- .1 Fill surface honeycomb and variations with latex filler.

3.3 VAPOUR RETARDER APPLICATION

- .1 Torch apply membrane onto substrate, overlapping side and end laps to manufacturer's written recommendations. .
- .2 Stagger laps a minimum of 300 mm.
- .3 Begin work at bottom of slopes; torch membrane so a visible bead of bitumen appears as the membrane is unrolled, ensuring the vapour retarder's complete adherence. .
- .4 Meet and overlap perimeter strip to air/vapour barrier on adjoining walls.
- .5 Seal membrane at insulation perimeters and around penetrations to ensure sealed connections with base sheet at upstands.

3.4 INSULATION APPLICATION

- .1 Install insulation to manufacturer's written instructions.
- .2 Ensure vapour retarder is clean and dry.
- .3 Place tapered thickness insulation to required slope pattern, to manufacturer's written instructions.
- .4 Place constant thickness first layer and second layer tapered thickness insulation to required slope pattern, to manufacturer's written instructions.
- .5 Mechanically fasten insulation to deck at full roof area to insulation manufacturer's written instructions.
- .6 Place eight (8) fasteners per insulation board.
- .7 Minimum Total Insulation Thickness: as required.
- .8 Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- .9 Lay tapered boards for a distance of 600 mm back from roof drains for positive drainage.
- .10 Apply no more insulation than can be covered with membrane in same day.
- .11 Install cover boards to manufacturer's written instructions. .

3.5 MEMBRANE APPLICATION

- .1 Apply membrane and primer to manufacturer's written instructions.
- .2 Apply membrane; lap and seal edges and ends permanently waterproof.
- .3 Apply membrane smooth, free from air pockets, wrinkles, or tears. Ensure full bond of membrane to substrate.
- .4 Extend membrane up cant strips and minimum of 200 mm onto vertical surfaces.
- .5 Extend membrane over air/vapour barrier of wall construction and seal with mastic adhesive.
- .6 Mop and seal membrane around roof protrusions and penetrations.
- .7 Provide waterproof cut-off to membrane at end of day's operation. Remove cut-off before resuming roofing.

3.6 FLASHINGS AND ACCESSORIES

- .1 Apply flexible sheet base flashings to seal membrane to vertical elements.
- .2 Complete installation of base sheet flashing prior to installing cap sheet membrane.
- .3 Install in accordance with manufacturer's recommendations, including the following instructions:
 - .1 Nail and torch base sheet flashing and torch cap sheet flashing onto substrate in 1000 mm (39 inch) wide strips. Secure to nailing at 100 mm on centre.

- .2 Lap base sheet flashing to base sheet membrane minimum 150 mm (6 inch) and seal.
- .3 Lap cap sheet flashing to cap sheet membrane 250 mm (10 inch) minimum and torch weld.
- .4 Provide 75 mm (3 inch) minimum side lap and seal.
- .5 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.
- .4 Coordinate installation of roof drains and roof sumps and related flashings.
- .5 Seal flashings and flanges of items penetrating or protruding through the membrane.

3.7 CLEANING

- .1 Section 01 74 00: Cleaning installed work.
- .2 In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
- .3 Repair or replace defaced or disfigured finishes caused by work of this section.

3.8 PROTECTION OF FINISHED WORK

- .1 Section 01 78 40: Protecting installed work.
- .2 Protect building surfaces against damage from roofing work.
- .3 Where traffic must continue over finished roof membrane, protect surfaces.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Precoated roofing, associated integral flashings, and underlayment.
- .2 Counterflashings.
- .3 Integral gutters.
- .4 Snow guards.
- .5 Integral fascias.

1.2 RELATED SECTIONS

- .1 Section 06 11 00 - Wood Framing: Plywood roof deck substrate.
- .2 Section 07 21 13 - Board Insulation: Rigid insulation under sheet metal roofing system.
- .3 Section 07 62 00 - Sheet Metal Flashing and Trim.
- .4 Section 08 63 00 - Metal Framed Skylights.
- .5 Section 07 92 00 - Joint Sealants.
- .6 Mechanical - Flashing sleeves and collars for electrical items protruding through roofing.
- .7 Electrical: Flashing sleeves and collars for electrical items protruding through roofing.

1.3 REFERENCES

- .1 ASTM A653/A653M-13 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 CAN/CGSB 51.34-M86 - Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .3 NRCA - Roofing Manual.
- .4 SMACNA 1120 - Architectural Sheet Metal Manual, 7th Edition (2012).

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
- .3 Pre-installation Meetings: Convene one (1) week before starting work of this section.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data on metal types, finishes and characteristics.
- .3 Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.6 QUALITY ASSURANCE

- .1 Fabricator Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience.
- .2 Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience and approved by the manufacturer.

1.7 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.
- .2 Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- .3 Prevent contact with materials which may cause discolouration or staining.

1.8 WARRANTY

- .1 Section 01 78 10: Warranties.
- .2 Provide a ten (10) year warranty to include coverage for failure to meet specified requirements.
- .3 Warranty: Include coverage for water tightness and degradation of metal finish.

Part 2 Products

2.1 PERFORMANCE

- .1 Metal roof panels shall be capable of withstanding a 250 pound concentrated load applied to a 4 square inch area in the middle of the panel. No noticeable buckling or permanent distortion of the panel shall occur.
- .2 Water Penetration under Static Pressure: Provide metal roof panel systems designed to resist penetration of water under static pressure. Testing shall be based on ASTM E331. Roof panels when tested shall have no water leakage at 40.0 pounds per square foot.
- .3 Air Infiltration: Provide metal roof panel assemblies designed to resist air infiltration. Testing shall be done based on ASTM E283 and E1680. Roof panels when tested shall have a maximum air leakage of 0.153 cfm per square feet of fixed roof area at a minimum static air-pressure differential of 40.0 foot pounds per square foot.
- .4 Roof assembly shall comply with UL 580 for wind uplift resistance; class UL 90.

2.2 SHEET MATERIALS

- .1 Pre-Coated Galvanized Steel: ASTM A653/A653M, Z275 zinc coating designation; 0.6 mm core steel. Shop pre-coated with modified silicone coating; colour as selected from standard range.
- .2 Panel Size: width of 28" by full length of slope.
- .3 Panel Profile: AR-50 by Agway Metal or similar.

2.3 ACCESSORIES

- .1 Roof panel accessories: Provide accessories as required for a complete installation. Accessories shall be as indicated on approved shop drawings and per manufacturer's approved standard details. Match material and finish of metal roof panels.
 - .1 Fasteners: As recommended by panel manufacturer.
 - .2 Concealed Anchor Clips: Two piece, floating anchor clip to manage movement.
 - .3 Backing Plates: Provide metal backing plates at panel end splices fabricated from material recommended by manufacturer.
 - .4 Closure Strips: Provide closed cell closure strips, minimum 1 inch thick matching metal roof panel profile.
- .2 Flashing and Trim:
 - .1 Fabricate flashing from same material as roof panels unless otherwise noted. Finish to match metal roof panels.
 - .2 Locations include, but are not limited to the following: Drips, eave and rake edges, roof penetrations, hips, valleys, and seamless hidden gutter.
- .3 Panel Sealant:
 - .1 Joint Sealant: ASTM C920 as recommended in writing by metal roof panel manufacturer.
 - .2 Butyl Tape: Per panel manufacturer's recommendations for panel to panel and panel to trim seal.
 - .3 Butyl Sealants: Non-skinning type per panels manufacturer's recommendations.
- .4 Snow Guards:
 - .1 A commercial pre-manufactured snow guard system.
 - .2 Materials: Clamps, brackets, rods and clips shall be fabricated from 6061-T6 aluminum extrusions conforming to ASTM B221 or aluminum castings conforming to ASTM B85.
 - .3 Clamp Model: As recommended by clamp manufacturer and as approved by metal roof panel manufacturer.
 - .4 Design: 9.5 mm diameter single rod design with attached snow clip.
 - .5 Fasteners: Stainless steel.
 - .6 Location: As noted on elevation drawings.

- .5 Waterproof membrane and roof underlayment
 - .1 Provided by Section 07 27 13 - Air and Air/Vapour Barriers

2.4 SHOP FABRICATION

- .1 Form sections true to shape, accurate in size, square, and free from distortion or defects.
- .2 Fabricate starter strips of same material as sheet, continuous, interlockable with sheet.
- .3 Form pieces in single length sheets.
- .4 Hem exposed edges on underside 13 mm; mitre and seam corners.
- .5 Form material with standing seams.
- .6 Fabricate corners from one piece with minimum 450 mm long legs; seam for rigidity, seal with sealant.
- .7 Fabricate vertical faces with bottom edge formed outward 6 mm and hemmed to form drip.
- .8 Fabricate flashings to allow toe to extend 50 mm over roofing paver. Return and brake edges.
- .9 Form sheet metal pans (pitch pockets) 150 mm nominal size, with 75 mm upstand, and 100 mm flanges.
- .10 Fabricate snow guards as detailed.

2.5 FINISHES

- .1 Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 0.4 mm.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Inspect roof deck to verify deck is clean and smooth, free of depressions, waves, or projections, properly sloped to drains.
- .3 Verify deck is dry and free of snow or ice. Verify joints in wood deck are solidly supported and fastened.
- .4 Verify correct placement of wood nailers and insulation positioning between nailers.
- .5 Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, reglets are in place, and nailing strips located.
- .6 Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

- .1 Install starter and edge strips, and cleats before starting installation.
- .2 Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.

3.3 INSTALLATION

- .1 Conform to drawing details relevant and included in the SMACNA 1120 manual.
- .2 Apply underlayment 50 mm. Minimize nail quantity.
- .3 Cleat and seam all joints.
- .4 Stagger transverse joints of roofing sheets.
- .5 Provide formed metal pans for protrusions through roof. Fill pans watertight with plastic cement.
- .6 Provide integral gutters.
- .7 Back paint surfaces in contact with dissimilar materials.
- .8 Solder lap joints. After soldering, wash metal clean with neutralizing solution, rinse with water.

3.4 STANDING SEAM ROOFING

- .1 Space standing seams at 600 mm on centre.
- .2 Lay sheets with long dimension perpendicular to eaves. Apply pans beginning at eaves.
- .3 Lock cleats into seams and flatten.
- .4 At eaves and gable ends, terminate roofing by hooking over edge strip.
- .5 Finish standing seams 25 mm high on flat surfaces 13 mm.
- .6 Bend up one side edge 38 mm and other edge 44 mm.
- .7 Make first fold 6 mm wide single fold and second fold 13 mm wide, providing locked portion of standing seam, five (5) plies in thickness.
- .8 Fold lower ends of seams at eaves over at 45 degree angle.
- .9 Terminate standing seams at ridge and hips by turning down with tapered fold.
- .10 Form valleys of sheets not exceeding 3 m in length. Lap joints 150 mm in direction of drainage.
- .11 Extend valley sheet minimum 150 mm under roofing sheets.
- .12 At valley, double fold valley and roofing sheets and secure with cleats spaced 400 mm on centre.

3.5 BUILT-IN GUTTERS

- .1 Secure gutter lining to substrate with cleats spaced minimum 600 mm on centre along edges of gutters.

- .2 Longitudinal joints not acceptable.
- .3 At roof edges, extend gutter lining under metal roofing 150 mm minimum and terminate in 19 mm folded edge secured by cleats. Hook lower end of roofing into lock strip to form 19 mm wide loose-lock seam.
- .4 Seal gutters watertight. Seal joint of gutter to drain, with suitable sealant.

3.6 FLASHINGS

- .1 Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
- .2 Cleat and seam all joints.
- .3 Apply plastic cement compound between metal flashings and felt flashings.
- .4 Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- .5 Install snow guards 600 mm up slope from eaves and valleys.
- .6 Seal metal joints watertight.

3.7 FIELD QUALITY CONTROL

- .1 Section 01 45 00: Field inspection.

3.8 PROTECTION OF FINISHED WORK

- .1 Section 01 78 40: Protecting installed work.
- .2 Do not permit traffic over unprotected roof surface.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Metal cap and sill flashings.
- .2 Metal counter flashings.

1.2 RELATED SECTIONS

- .1 Section 06 10 13 - Wood Blocking and Curbing: Wood blocking for metal roofing substrate profiles.
- .2 Section 07 52 11 - SBS/APP Modified Bitumen Membrane - Conventional
- .3 Section 07 61 00 - Sheet Metal Roofing.
- .4 Section 07 92 00 - Joint Sealants.
- .5 Section 08 44 13 - Glazed Aluminum Curtain Wall: Flashing at Aluminum Skylight.
- .6 Mechanical: Flashing sleeves and collars for mechanical items protruding through roofing membrane.
- .7 Electrical: Flashing sleeves and collars for electrical items protruding through roofing membrane.

1.3 REFERENCES

- .1 ASTM A653/A653M-10 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 SMACNA - Architectural Sheet Metal Manual, 2003.
- .3 Canadian Roofing Contractor's Association (CRCA) Specifications Manual 2012

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Shop Drawings: Hidden Gutter System: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.6 CLOSEOUT SUBMITTALS

1.7 QUALITY ASSURANCE

- .1 Fabricator Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.
- .2 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.

1.8 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.
- .2 Stack material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- .3 Prevent contact with materials which may cause discolouration or staining.

Part 2 Products

2.1 SHEET MATERIALS

- .1 Pre-Coated Galvanized Steel: ASTM A653/A653M, Z275 zinc coating designation; 0.6 mm core steel. Shop pre-coated with modified silicone PVDF coating; colour to match adjacent cladding materials.

2.2 ACCESSORIES

- .1 Fasteners: Concealed fasteners, galvanized steel.
- .2 Underlayment: Membrane flashing to be supplied and installed by Section 07 27 13.
- .3 Protective Backing Paint: Bituminous.
- .4 Sealant: specified in Section 07 92 00

2.3 COMPONENTS

- .1 Hidden Gutters: Shop drawing to be provided. Refer to SMACNA, Architectural Sheet Metal Manual for best practise fabrication details. Non-sloped (flat) gutter to be seamless design or solder welded joints if required.
- .2 Internal downspouts: Drain and internal downspouts to be provided by mechanical plumbing contractor.

2.4 FABRICATION

- .1 Form sections true to shape, accurate in size, square, and free from distortion or defects.
- .2 Fabricate cleats of same material as sheet, interlockable with sheet.
- .3 Form pieces in longest possible lengths.

- .4 Hem exposed edges on underside 13 mm; mitre and seam corners.
- .5 Fabricate corners from one piece with minimum 450 mm long legs; seam for rigidity, seal with sealant.
- .6 Fabricate vertical faces with bottom edge formed outward 6 mm and hemmed to form drip.
- .7 Form sheet metal pans (pitch pockets) 50 mm nominal size, with 75 mm up-stand, and 100 mm flanges.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, reglets in place, and nailing strips located.
- .3 Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

- .1 Install starter and edge strips, and cleats before starting installation.
- .2 Install surface mounted reglets true to lines and levels. Seal top of reglets with sealant.

3.3 INSTALLATION

- .1 Conform to typical drawing details found in the current SMACNA - Architectural Sheet Metal Manual.
- .2 Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted by Department Representative.
- .3 Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- .4 Seal metal joints watertight.
- .5 Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Gutters.
- .2 Downspouts.
- .3 Splash pads.

1.2 RELATED SECTIONS

- .1 Section 07 61 00 - Sheet Metal Roofing.
- .2 Section 07 62 00 - Sheet Metal Flashing And Trim.
- .3 Division 22 - Plumbing: Plastic pipe boots, with connection to downspout at 150 mm above grade.
- .4 Division 26 - Electrical: Electric heating cable.
- .5 Division 33 - Utilities: Connection of downspouts to storm sewer.

1.3 REFERENCES

- .1 ASTM A653/A653M-13 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .2 ASTM B32-08 - Standard Specification for Solder Metal.
- .3 SMACNA 1120 - Architectural Sheet Metal Manual, 7th Edition (2012).

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the work with downspout discharge pipe inlet.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data on prefabricated components.
- .3 Shop Drawings: Indicate locations, configurations, jointing methods, fastening methods, locations, and installation details.
- .4 Samples: Submit two (2) samples, 150 mm long illustrating component design, finish, colour, and configuration.

1.6 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.

- .2 Stack preformed prefinished and preformed material to prevent twisting, bending, or abrasion, and to provide ventilation. Slope to drain.
- .3 Prevent contact with materials during storage which may cause discolouration, staining, or damage.

Part 2 Products

2.1 MATERIALS

- .1 Downspouts: Pre-Coated Galvanized Steel: ASTM A653/A653M, Z275 zinc coating designation; 22 gauge core steel; shop pre-coated with PVDF coating, colour to match roof.
- .2 Gutters: Galvanized Steel: ASTM A653/A653M, Z275 zinc coating designation, 22 gauge core steel.

2.2 COMPONENTS

- .1 Gutters: 150 mm Box Style profile.
- .2 Downspouts: 100 x 75 mm Rectangular profile.
- .3 Accessories: Profiled to suit gutters and downspouts.
- .4 Splash Pads: Precast concrete type, 610 x 610; minimum 21 MPa at 28 days, with minimum 5% air entrainment.
- .5 Downspout Boots: PVC.

2.3 ACCESSORIES

- .1 Anchorage Devices: Type recommended by fabricator.
- .2 Gutter Supports: heavy gauge stainless steel hanger cross bars 610mm on center.
- .3 Downspout Supports: Brackets.
- .4 Fasteners: Galvanized steel, with soft neoprene washers. Finish exposed fasteners same as flashing metal.
- .5 Protective Back Coating: Bituminous.
- .6 Solder: ASTM B32; 50/50 type.

2.4 FABRICATION

- .1 Form gutters and downspouts of profiles and size indicated.
- .2 Fabricate with required connection pieces.
- .3 Form sections square, true, and accurate in size, in maximum possible lengths, free of distortion or defects detrimental to appearance or performance. Allow for expansion at joints.
- .4 Hem exposed edges of metal.
- .5 Fabricate gutter and downspout accessories; solder watertight.

2.5 FINISHES

- .1 Apply bituminous protective backing on surfaces in contact with dissimilar materials.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that surfaces are ready to receive work.

3.2 INSTALLATION

- .1 Install gutters, downspouts, and accessories to manufacturer instructions.
- .2 Join lengths with formed seams soldered watertight. Flash and seal gutters to downspouts and accessories.
- .3 Slope gutters 1 mm per m maximum.
- .4 Solder metal joints for full metal surface contact. After soldering, wash metal clean with neutralizing solution and rinse with water.
- .5 Connect downspouts to downspout boots system. Seal connection watertight.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Fireproof firestopping and fire-safing materials and accessories, including firestopping of mechanical and electrical service penetrations.

1.2 REFERENCES

- .1 CAN/ULC-S101-07 - Standard Methods of Fire Endurance Tests of Building Construction and Materials.
- .2 CAN/ULC-S102-10 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .3 CAN/ULC-S115m-05 - Standard Method of Fire Tests of Firestop Systems.
- .4 FM (Factory Mutual) - FM 4991-2001, Approval Standard for Approval of Firestop Contractors.
- .5 FCIA (Firestop Contractors International Association) - Manual of Practice.
- .6 NFPA 251 - Standard Methods of Tests of Fire Endurance of Building Construction and Materials, 2006 edition.
- .7 ULC - Building Materials Directory.

1.3 DEFINITIONS

- .1 Firestopping (Fire-safing): A sealing or stuffing material or assembly placed in spaces between building materials to arrest the movement of smoke, heat, gases, or fire through wall or floor openings.

1.4 SYSTEM DESCRIPTION

- .1 Firestopping systems installed to resist spread of fire and passage of smoke and other gases at penetrations through fire resistance rated wall and floor assemblies, materials and components.

1.5 PERFORMANCE REQUIREMENTS

- .1 Materials, accessories and application procedures listed by ULC, or tested to CAN/ULC-S115m to comply with building code requirements.
- .2 Firestopping Materials: CAN/ULC-S101 to achieve a fire rating as noted on Drawings.

1.6 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination: Coordinate with other work having a direct bearing on work of this section.
- .3 Pre-installation Meetings: Convene one (1) week before starting work of this section.

1.7 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data on product characteristics, performance and limitation criteria, as specified..
- .3 System Design Listings: Submit system design listings, including illustrations from a qualified testing and inspection agency that is applicable for each firestop configuration.

1.8 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience and FAIC Manufacturer Member in good standing.
- .2 Contractor Qualifications: Company specializing in performing the work of this section
 - .1 Licensed by the province or local authority where applicable.
 - .2 Successfully completed not less than five (5) comparable scale projects.
- .3 Single Source Responsibility: Obtain firestop systems for each type of penetration and construction situation from a single primary firestop systems manufacturer.

1.9 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.
- .2 Deliver firestopping products in original, unopened containers with labels intact and legible, identifying product and manufacturer.
- .3 Store and handle firestopping materials to manufacturer's instructions.

1.10 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 26: Environmental conditions affecting products on site.
- .2 Do not apply materials when temperature of substrate material and ambient air is below manufacturer's recommendations.
- .3 Provide ventilation to manufacturer's instructions in areas to receive solvent cured materials

Part 2 Products

2.1 MANUFACTURERS

- .1 Provide firestopping and smoke seal systems only from manufacturers publishing ULC Listed or UL Certified for Use in Canada System Designs tested in accordance with CAN/ULC-S115mm:
 - .1 Acceptable Manufacturers: A/D Fire, Grace, Hilti, 3M.

2.2 ACCEPTABLE PRODUCTS

- .1 Selection of appropriate system to maintain required fire resistance rating is the responsibility of the Installer. All systems or EJs are to be submitted for review. Systems must be asbestos-free.
- .2 Selection to be based on specified performance requirements and is limited to ULC Listed or UL Certified for Use in Canada System Designs tested in accordance with CAN/ULC S115m.
- .3 Substitution of products, components or accessories forming part of a System Design is not acceptable, unless accompanied by an EJ or EFRRRA from the system manufacturer.

2.3 ACCESSORIES

- .1 Primer: Type recommended by firestopping manufacturer for specific substrate surfaces.
- .2 Installation Accessories: Clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping are ready to receive the work of this section.
- .3 Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- .1 Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter which may affect bond of firestopping material.
- .2 Remove incompatible materials which may affect bond.
- .3 Install damming and backing materials to arrest liquid material leakage.

3.3 APPLICATION

- .1 Apply primer and firestopping materials to manufacturer's written instructions.
- .2 Install material at walls or partition openings which contain penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- .3 Apply firestopping material in sufficient thickness to achieve rating, to uniform density and texture.
- .4 Dam Material: Dam material to remain.

3.4 CLEANING

- .1 Section 01 74 00: Cleaning installed work.
- .2 Clean adjacent surfaces of firestopping materials.

3.5 PROTECTION OF FINISHED WORK

- .1 Section 01 78 40: Protecting installed work.
- .2 Protect adjacent surfaces from damage by material installation.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Preparing substrate surfaces.
- .2 Sealant and joint backing.
- .3 Structural sealant for glazing assemblies.

1.2 RELATED SECTIONS

- .1 Section 03 30 00 - Cast-in-Place Concrete: Sealants required in conjunction with cast-in-place concrete.
- .2 Section 04 26 19 - Reinforced Unit Masonry.
- .3 Section 07 13 00 - Sheet Membrane Waterproofing: Sealants required in conjunction with waterproofing.
- .4 Section 07 27 13 - Modified Bituminous Sheet Air/Vapour Barrier: Sealants required in conjunction with air barrier.
- .5 Section 07 52 11 - SBS/APP Modified Bitumen Membrane - Conventional
- .6 Section 07 62 00 - Sheet Metal Flashing and Trim: Sealants required in conjunction with metal roofing.
- .7 Section 07 84 00 - Firestopping: Sealants required in conjunction with firestopping.
- .8 Section 08 11 13 - Metal Doors and Frames: Sealants required in conjunction with door frames.
- .9 Section 08 51 13 - Aluminum Windows: Sealants required in conjunction with aluminum windows.
- .10 Section 08 80 50 - Glass and Glazing: Sealants required in conjunction with glazing methods.

1.3 REFERENCES

- .1 ASTM C834-10 - Standard Specification for Latex Sealants.
- .2 ASTM C919-08 - Standard Practice for Use of Sealants in Acoustical Applications.
- .3 ASTM C920-11 - Standard Specification for Elastomeric Joint Sealants.
- .4 ASTM C1184-05 - Standard Specification for Structural Silicone Sealants.
- .5 ASTM C1193-09 - Standard Guide for Use of Joint Sealants.
- .6 ASTM C1401-09a - Standard Guide for Structural Sealant Glazing.
- .7 ASTM E330-02(2010) - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.

1.4 PERFORMANCE REQUIREMENTS

- .1 Sealant Design: Design structural sealant to withstand specified loads without breakage, loss, failure of seals, product deterioration, and other defects.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the work with all sections referencing this section.

1.6 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, colour availability .
- .3 Structural Sealant Joint Design: Confirmation design data provided by installer has been reviewed and approved by sealant manufacturer.

1.7 CLOSEOUT SUBMITTALS

1.8 QUALITY ASSURANCE

- .1 Perform work to sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- .2 Perform sealant application work to ASTM C1193.
- .3 Perform structural sealant application work to ASTM C1401.
- .4 Perform acoustical sealant application work to ASTM C919.
- .5 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.
- .6 Applicator Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.

1.9 MOCK-UP

- .1 Section 01 43 00: Requirements for mock-up.
- .2 Provide mock-up to include sealant joints in conjunction with building envelope.
- .3 Construct mock-up with specified sealant types and with other components noted.
- .4 Locate where directed by Department Representative.
- .5 Approved mock-up may remain as part of the Work.

1.10 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 26: Environmental conditions affecting products on site.
- .2 Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.
- .3 VOC Limitations: for all materials supplied by this Section, the total VOC content must be less than or equal to 250 g/L, less water, when tested to ASTM D2369.
- .4 Comply with requirements of Workplace Hazardous Materials Information System(WHMIS) regarding use, handling, storage, and disposal of hazardous materials; and regarding labelling and provision of material safety data sheets acceptable to Labour Canada.

1.11 WARRANTY

- .1 Section 01 78 10: Warranties.
- .2 Provide a one (1) year extended warranty to include coverage for failure to meet specified requirements.
- .3 Warranty: Include coverage for replacements parts and labour.

Part 2 Products

2.1 SEALANTS

- .1 Sealant Type A: for use in areas not subject to traffic, including exterior joints in metal, precast, and masonry cladding systems and at window frame perimeter joints.
 - .1 Component Polyurethane sealant.
- .2 Sealant Type B: for use in areas not subject to traffic including interior joints in cladding systems, between windows, door frames and screen frames.
 - .1 Moisture curing urethane sealant: meeting CAN/CGSB 19.13 Class MC-2-25-B-N.
- .3 Sealant Type C: one part elastomeric sealants: to meet specified requirements of NSC/CGSB Specification CAN2-19.13.
 - .1 Classification MCG-2-25-A-L medium modulus silicone, to be used in glass to glass, glass to metal, and metal to metal joints.
 - .2 Classification MC-2-25-B-N moisture curing hybrid polyurethane, to be used at exterior and interior locations as shown.
- .4 Sealant Type D: for use in areas which may be exposed to traffic and movement including control, expansion and isolation joints in exterior and interior horizontal pavements, expansion and isolation joints in interior concrete floors, and control joints in interior tile floors.
 - .1 Chemical curing, 2 component self levelling urethane sealant meeting CAN/CGSB19.24 M-90 Type 1.

- .5 Sealant Type E: for use not subject to traffic including interior joints between plumbing fixtures and their contact surfaces and plastics laminate surfaces and their contact surfaces. Mildew resistant, one part, silicone, moisture curing sealant meeting CAN/CGSB19.22-M89.
- .6 Sealant Type F: acoustical sealant. One part sealant; to meet specified requirements of CAN/CGSB 19-GP-21M; use at all perimeter joints and openings in drywall systems as shown.
- .7 Sealant Type G: for use on interior joints in drywall, around interior door and window frames, subject to minimal movement, where a fast set and paintability within one hour are required.

2.2 ACCESSORIES

- .1 Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- .2 Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- .3 Joint Backing: ASTM C1330; round, closed cell polyethylene foam rod; oversized to suit joint width.
- .4 Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.
- .5 Masking tape: Non-staining, non-absorbent type compatible with sealant and adjacent surfaces.
- .6 Setting Blocks and Spacers: Compatible with silicone sealant and recommended by sealant manufacturer.

2.3 COLOURS

- .1 Unless indicated otherwise, in respective technical specification sections, colour selection is to be by Department Representative, from standard range.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that joint openings and substrate surfaces are clean, dry, and free of frost and ready to receive work.
- .3 Verify that joint backing and release tapes are compatible with sealant sealant.

3.2 PREPARATION

- .1 Remove loose materials and foreign matter which might impair adhesion of sealant.
- .2 Clean and prime joints to sealant manufacturer's written instructions.

- .3 Perform preparation to ASTM C1193 for solvent release and latex base sealants.
- .4 Protect elements surrounding the work of this section from damage or disfiguration.

3.3 INSTALLATION

- .1 Perform installation in accordance with ASTM C1193 for solvent release and latex base sealants.
- .2 Measure joint dimensions and size materials to achieve required width/depth ratios.
- .3 Install joint backing to achieve a neck dimension no greater than 1/3 of the joint width.
- .4 Install bond breaker where joint backing is not used.
- .5 Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- .6 Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- .7 Tool joints concave.

3.4 FIELD QUALITY CONTROL

- .1 Section 01 45 00: Field testing and inspection.
- .2 Joint Sealants: Perform adhesion tests to manufacturer's written instructions and ASTM C1193, Method A - Field-Applied Sealant Joint Hand Pull Tab.
 - .1 Perform test twenty-one (21) days after installation at a rate of one test every 300 m of installed sealant.
- .3 Remove sealants failing adhesion test, clean substrates, reinstall sealants and perform retesting.
- .4 Maintain test log and submit report to Department Representative indicating tests, locations, dates, results, and remedial actions.

3.5 CLEANING

- .1 Section 01 74 00: Cleaning installed work.
- .2 Clean adjacent soiled surfaces.

3.6 PROTECTION OF FINISHED WORK

- .1 Section 01 78 40: Protecting installed work.
- .2 Remove masking tape and excess sealant.
- .3 Protect sealants until cured, remove temporary glass supports.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Pressed steel frames.
- .2 Hollow metal doors.
- .3 Interior glazed light frames; glass and glazing.

1.2 RELATED SECTIONS

- .1 Section 04 04 05 - Mortar and Masonry Grout: Masonry grout fill of metal frames.
- .2 Section 07 92 00 - Joint Sealants.
- .3 Section 08 71 00 - Door Hardware - General: Hardware, weatherstripping.
- .4 Section 08 80 50 - Glazing.
- .5 Section 09 91 10 - Painting: Field painting of doors.

1.3 REFERENCES

- .1 CAN4-S104-M80 (R1985) - Fire Tests of Door Assemblies.
- .2 CAN4-S105-85 (R1992) - Fire Door Frames Meeting the Performance Required by CAN4-S104.
- .3 CAN/ULC-S701-11 - Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.
- .4 CAN/ULC-S702-09 - Standard for Mineral Fibre Thermal Insulation for Buildings.
- .5 CAN/ULC-S704-11 - Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
- .6 CSA-G40.20-04/G40.21-04 (R2009) - General Requirements for Rolled or Welded Structural Quality Steel/ Structural Quality Steel.
- .7 CSA-W59-03 (R2008) - Welded Steel Construction (Metal Arc Welding).
- .8 CSDMA (Canadian Steel Door Manufacturers Association).
 - .1 Recommended Dimensional Standards for Commercial Steel Doors and Frames, 2000.
 - .2 Selection and Usage Guide for Commercial Steel Doors and Frames, 2009.
- .9 DHI A115.16-1994 - Installation Guide For Doors And Hardware.
- .10 NFPA 80 - Standard for Fire Doors and Other Opening Protectives, 2010 Edition.
- .11 NFPA 252 - Fire Tests of Door Assemblies (2008 Edition).

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.

- .2 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the work with frame opening construction, door, and hardware installation.
- .3 Sequencing: Sequence installation to ensure wire connections are achieved in an orderly and expeditious manner.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Indicate door and frame configurations and finishes, location of cut-outs for hardware reinforcement.
- .3 Shop Drawings:
 - .1 Indicate frame elevations, reinforcement, anchor types and spacing, location of cut-outs for hardware, and finish.
 - .2 Indicate door elevations, internal reinforcement, closure method, and cut-outs for louvers and finishes.

1.6 CLOSEOUT SUBMITTALS

1.7 QUALITY ASSURANCE

- .1 Conform to requirements of CSDMA. Maintain one (1) copy of document on site.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

1.8 REGULATORY REQUIREMENTS

- .1 Fire Rated Door and Frame Construction: Labelled and listed to CAN4-S104 and NFPA 252.

1.9 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.
- .2 Remove doors and frames from wrappings or coverings upon receipt on site and inspect for damage.
- .3 Store in vertical position, spaced with blocking to permit air circulation between components.
- .4 Store materials on planks or dunnage, out of water and covered to protect from damage.
- .5 Clean and touch up scratches or disfigurement caused by shipping or handling with zinc-rich primer.

1.10 WARRANTY

- .1 Section 01 78 10: Warranties.
- .2 Provide extended warranty to include coverage for failure to meet specified requirements, to the following term:
 - .1 Exterior Doors: Four (4) Years
 - .2 Interior Doors: Four (4) Years

Part 2 Products

2.1 MATERIALS

- .1 Sheet Steel: Galvanized steel to ASTM A653/A653M, commercial grade (CS), Type B.
 - .1 Exterior Doors: coating designation G90.
 - .2 Interior Doors: Coating designation Z75.
- .2 Reinforcement channel: To CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653/A653M.

2.2 DOOR CORE MATERIALS

- .1 Honeycomb Core: Structural small cell 25.4 mm maximum kraft paper honeycomb; weight 36.3 kg per ream minimum, density 16.5 kg/cu m minimum, sanded to required thickness.
- .2 Polystyrene Core: ASTM C578, Type 1, rigid extruded fire retardant, closed cell board, density 16 to 32 kg/cu m and RSI- thermal values RSI 1.0 minimum, Type 1, in accordance with CAN/ULC-S701.
- .3 Temperature Rise Rated (TRR): Core composition to provide fire-protection rating and limit temperature rise on unexposed side of door to 250degrees C at 30 or 60 minutes, as determined by governing code requirements, core tested as part of a complete door and frame assembly, to CAN4-S104, and listed by a nationally recognized testing agency having a factory inspection service.

2.3 ADHESIVES

- .1 Cores and Steel Components: Heat resistant, structural reinforced epoxy, resin based adhesive.
- .2 Lock Seam: Reinforced epoxy resin, high viscosity, thicksotropic sealant.

2.4 PRIMERS

- .1 Primer: Rust inhibitive touch-up only.

2.5 ACCESSORIES

- .1 Door Silencers: Single stud rubber/neoprene.

- .2 Exterior Top Caps: Rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19MA.
- .3 Frame Thermal Breaks: Rigid polyvinylchloride extrusion conforming to CGSB 41-GP-19MA.
- .4 Removable Glazing Stops: Formed galvanized steel channel, minimum 16 mm high, accurately fitted, butted at corners and fastened to frame sections with counter-sunk tamper proof sheet metal screws.
- .5 Bituminous Coating: Fibred asphalt emulsion.
- .6 Louvres:
 - .1 Material and Finish: Roll formed aluminum; wipe coat of zinc.
 - .2 Louver Blade: Inverted chevron blade, sightless.
- .7 Glass: As specified in Section 08 80 50.

2.6 FABRICATION - DOORS

- .1 Exterior Doors: Laminated core construction.
- .2 Interior Doors: Laminated core construction.
- .3 Longitudinal Edges: mechanically inter-locked, adhesive assisted with no visible edge seams.
- .4 Mortised, blanked, reinforced, drilled and tapped for templated hardware, in accordance with templates provided by hardware supplier.
- .5 Reinforce for surface mounted hardware, anchor hinges, thrust pivots, pivot reinforced hinges, or non-templated hardware.
- .6 Top and Bottom Channels: Inverted, recessed, welded steel channels.
- .7 Exterior Door: Flush PVC top caps.
- .8 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.

2.7 LAMINATED CORE CONSTRUCTION

- .1 Exterior Doors: Both face sheets 1.6 mm steel, with polystyrene core, laminated under pressure to face sheets.
- .2 Interior Doors: Both face sheets 1.6 mm steel with honeycomb core and temperature rise rated core where scheduled, laminated under pressure to face sheets.

2.8 FABRICATION - FRAMES

- .1 Exterior Frames: 1.6 mm thick base metal thickness.
 - .1 Frames: Welded type construction thermally broken.
 - .2 Transom Frames, Sidelight and Window Assemblies: Welded type construction thermally broken.
- .2 Interior Frames: 1.6 mm thick base metal thickness.

- .1 Door Frames and Window Assemblies: Welded type construction.
- .2 Transom Frames: welded type construction.
- .3 Sidelight Assemblies: Welded type construction.
- .3 Mullions for Double Doors: fixed and removable type, of same profiles as jambs.
- .4 Transom Bars for Glazed Lights: Fixed type, of same profiles as jamb and head.
- .5 Mortised, blanked, reinforced, drilled and tapped for templated hardware, in accordance with templates provided by hardware supplier. Provide mortar guard boxes.
- .6 Reinforce frames wider than 1200 mm with roll formed steel channels fitted tightly into frame head, flush with top.
- .7 Terminate door stops 150 mm above finished floor. Cut stop at 90 degree angle and close.
- .8 Prepare frames for silencers. Provide three (3) single silencers for single doors and mullions of double doors on strike side. Provide two (2) single silencers on frame head at double doors without mullions.
- .9 Configure exterior frames with special profile to receive recessed weatherstripping.
- .10 Attach fire rated label to each fire rated door unit.
- .11 Fabricate frames to suit masonry wall coursing with 50 mm head member.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that opening sizes and tolerances are acceptable; check floor area within path of door swing for flatness.
- .3 Verify doors and frames are correct size, swing, rating and opening number.
- .4 Remove temporary shipping spreaders.

3.2 INSTALLATION

- .1 Install doors and frames to CSDMA.
- .2 Install fire-rated doors and frames in accordance with NFPA 80, and local authority having jurisdiction.
- .3 Coordinate with masonry wall construction for anchor placement.
- .4 Coordinate installation of glass and glazing.
- .5 Coordinate installation of doors and frames with installation of hardware specified in Section 08 71 00.
- .6 Set frames plumb, square, level and at correct elevation.

- .7 Secure anchorages and connections to adjacent construction.
- .8 Brace frames rigidly in position while building-in. Install wood spreaders at third points of frame rebate height to maintain frame width. Provide vertical support at centre of head for openings exceeding 1200 mm in width.
- .9 Remove wood spreaders after frames have been built-in.
- .10 Make allowance for deflection to ensure structural loads are not transmitted to frame product.
- .11 Install doors, and hardware in accordance with hardware templates and manufacturer's instructions.
- .12 Adjust operable parts for correct clearances and function.
- .13 Install louvers, glazing and door silencers.
- .14 Finish paint as specified in Section 09 91 10.
- .15 Install roll formed steel reinforcement channels between two abutting frames. Anchor to structure and floor.

3.3 ERECTION TOLERANCES

- .1 Section 01 73 00: Tolerances.
- .2 Maximum Diagonal Distortion: 3mm measured with straight edges, crossed corner to corner.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Flush wood doors; flush and flush glazed configuration; non-rated and fire rated.

1.2 RELATED SECTIONS

- .1 Section 08 11 13 - Standard Metal Doors and Frames
- .2 Section 08 34 73 - Sound Coontrol Door Assemblies
- .3 Section 08 71 00 - Door Hardware - General.
- .4 Section 08 80 50 - Glass and Glazing.
- .5 Section 09 91 10 - Painting: Site touch up of doors.

1.3 REFERENCES

- .1 ASTM E413-10 - Classification for Rating of Sound Insulation.
- .2 AWMAC - Architectural Woodwork Standards (AWS) – 1st Edition, 2009.
- .3 CAN/ULC-S104-10 ☐ Standard Method for Fire Tests of Door Assemblies.
- .4 CAN4-S105M-85(R1992) - Fire Door Frames Meeting the Performance Required by CAN4-S104.
- .5 CHPVA (Canadian Hardwood Plywood and Veneer Association).
- .6 NFPA 80 - Standard for Fire Doors and Other Opening Protectives, 2010 Edition.
- .7 NFPA 252 - Fire Tests of Door Assemblies (2008 Edition).

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the work with door opening construction, door frame and door hardware installation.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- .3 Shop Drawings: Illustrate door opening criteria, elevations, sizes, types, swings, undercuts required, special beveling, special blocking for hardware, factory machining criteria, factory finishing criteria.

1.6 QUALITY ASSURANCE

- .1 Perform work in accordance with AWMAC Quality Standards, Custom Grade.
- .2 Finish doors in accordance with AWMAC Quality Standards to finish identified in schedule.
- .3 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience and a member in good standing with AWMAC.

1.7 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.
- .2 Package, deliver and store doors in accordance with AWMAC.
- .3 Accept doors on site in manufacturer's packaging. Inspect for damage.
- .4 Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.8 WARRANTY

- .1 Section 01 78 10: Warranties.
- .2 Provide extended warranty to include coverage for failure to meet specified requirements, to the following term:
 - .1 Interior Doors: Four (4) years.
 - .2 Include coverage for warping beyond specified installation tolerances.

Part 2 Products

2.1 MANUFACTURERS

- .1 Baillargeon; Product: Intense.
- .2 Other acceptable manufacturers offering functionally and aesthetically equivalent products.
 - .1 Lambton; Product: similar quality product.
 - .2 Lynden; Product: similar quality product.

2.2 DOOR LEAF TYPES

- .1 Interior Doors: 1 3/4" thick; solid core construction, fire and acoustic rated as indicated.

2.3 DOOR FACING

- .1 Veneer Facing (Interior Doors): AWMAC Custom quality species wood, rotary cut, with book matched grain, end match transoms for transparent finish.

- .1 Species: Natural Birch

2.4 FABRICATION

- .1 Fabricate non-rated doors in accordance with AWMAC Quality Standards requirements.
- .2 Fabricate fire rated doors in accordance with AWMAC Quality Standards and to ULC requirements. Attach fire rating label to door.
- .3 Sound Rating for Single Door Leaf and Frame Assembly: ASTM E413, minimum STC 50.
- .4 Provide lock blocks at top of door for closer for hardware reinforcement.
- .5 Vertical Exposed Edge of Stiles: Of same species as veneer facing, transparent finish.
- .6 Fit door edge trim to edge of stiles after applying veneer facing.
- .7 Bond edge banding to cores.
- .8 Factory machine doors for finish hardware in accordance with hardware requirements and dimensions. Do not machine for surface hardware. Provide solid blocking for through bolted hardware.
- .9 Factory fit doors for frame opening dimensions identified on shop drawings.
- .10 Provide edge clearances in accordance with AWMAC.

2.5 FINISHES

- .1 Factory finish doors in accordance with manufacture's standard quality.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that opening sizes and tolerances are acceptable.
- .3 Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.2 INSTALLATION

- .1 Install non-rated doors in accordance with AWMAC Quality Standards requirements.
- .2 Install fire rated doors to NFPA 80.
- .3 Trim non-rated door width by cutting equally on both jamb edges.
- .4 Trim door height by cutting bottom edges to a maximum of 3/4". Trim fire door height at bottom edge only, in accordance with fire rating requirements.
- .5 Machine cut for hardware.

- .6 Coordinate installation of doors with installation of frames specified in Section 08 11 13 and 08 34 73 and hardware specified in Section 08 71 00.
- .7 Coordinate installation of glass and glazing.
- .8 Install door louvres plumb and level.

3.3 INSTALLATION TOLERANCES

- .1 Section 01 73 00: Tolerances.
- .2 Conform to AWMAC requirements for fit and clearance tolerances.
- .3 Conform to AWMAC Section 1300 requirements for maximum diagonal distortion.

3.4 ADJUSTING

- .1 Adjust door for smooth and balanced door movement.
- .2 Adjust closer for full closure.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Access door and frame units.

1.2 RELATED SECTIONS

- .1 Section 03 30 00 - Cast-in-Place Concrete: Openings in concrete.
- .2 Section 09 29 00 - Gypsum Board Assemblies: Openings in partitions.
- .3 Section 09 51 13 - Acoustic Panel Ceilings: Openings in ceilings.
- .4 Section 06 10 13 - Wood Blocking and Curbing
- .5 Section 09 91 10 - Painting: Field paint finish.
- .6 Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC): Mechanical components requiring access.
- .7 Division 28 - Electronic Safety and Security: Electrical components requiring access panels.

1.3 REFERENCES

- .1 ULC-FR-14 - Fire Resistance Directory (2014 Edition).

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination: Coordinate with other work having a direct bearing on work of this section.
 - .1 Coordinate the work with other work requiring access doors.

1.5 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- .3 Shop Drawings: Indicate exact position of floor access door units. Also Indicate opening dimensions, framed opening tolerances, anchoring, drainage, affected related work, and installation requirements.

1.6 CLOSEOUT SUBMITTALS

- .1 Section 01 78 10: Submission procedures.
- .2 Record Documentation: Record actual locations of all access units.

1.7 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for fire rated access doors.

- .2 Provide certificate of compliance from authority having jurisdiction indicating approval of fire rated doors.

Part 2 Products

2.1 ACCESS UNITS - FLOORS

- .1 Fire Rated Hatch and Frame Unit: Formed stainless steel, 1 hr hour fire rating:
 - .1 In Concrete Floors: below grade water reservior.
 - .1 Product: J-4AL (914x914 mm, drainable), manufactured by Bilco.
 - .2 Other acceptable manufactures include:
 - .1 Acudor
 - .2 Nystrom

2.2 FABRICATION - WALL AND CEILING UNITS

- .1 Fabricate frames and flanges of 1.5 mm steel.
- .2 Fabricate door panels of 1.8 mm steel single thickness steel sheet.
- .3 Weld, fill, and grind joints to ensure flush and square unit.
- .4 Hardware:
 - .1 Hinge: 175 degree stainless steel piano hinge.
 - .2 Lock: Screw driver slot for quarter turn cam lock.

2.3 FINISHES - WALL AND CEILING UNITS

- .1 Base Metal Protection: Prime coat units with alkyd primer.
- .2 Finish: One (1) coat baked enamel, colour as selected.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that rough openings for door and frame are correctly sized and located.

3.2 INSTALLATION

- .1 Install units to manufacturer's written instructions.
- .2 Install frames plumb and level in opening. Secure rigidly in place.
- .3 Position unit to provide convenient access to concealed work requiring access.

END OF SECTION

1.0 GENERAL

1.1 SCOPE OF WORK

- .1 Supply and installation of all sliding detention cell doors, frame and hardware and fastening anchors.
- .2 Supply and installation of all glazing systems for Cell Doors including Polycarbonate Viewport glazing. Include Glazing as specified under Section 08 80 50.
- .3 Carry out the work under this section by utilizing specialized Security Equipment Suppliers and utilizing the specialized firm's installers. The specialized suppliers must be experienced manufacturers of Cell doors and frames and with demonstrated performance in the assembling and installation of coordinated security items included in RCMP detachments and to be generally the manufactures of major products supplied and installed by them.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- .1 Rough Carpentry Section 06 10 00
- .2 Caulking and Sealants Section 07 92 00
- .4 Hardware Section 08 71 00
- .5 Painting Section 09 91 10

1.3 REFERENCES

- .1 CSA W59-M1989, Welded Steel Construction (Metal Arc Welding).
- .2 ANSI/NAAMM – HMMA 863-04, Guide Specifications for Detention Security Hollow Metal Doors and Frames produced by National Association of Architectural Metal Manufacturers, 5th edition, dated January 2005.
- .3 HMMA – Hollow Metal Manufacturer Association, a Division of NAAMM.
- .4 ASTM A1008 / A1008M-08a, Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened and Bake Hardenable.
- .5 ASTM A1011 / A1011M-08, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability and Ultra-High Strength.
- .6 ASTM F1450-05, Standard Test Methods for Hollow Metal Swinging Door Assemblies for Detention Facilities.
- .7 RCMP Hollow Metal Door & Pressed Steel Frame Shop Drawings for Sliding and Swinging Cell Doors.”

1.4 SUBMITTALS

- .1 Submit shop drawings, product data, test report and compliance documentation specified below. Submit in accordance with Section 01 33 00.
- .2 Shop Drawings and Product Data:
 - .1 Provide door and frame schedule accompanied with detailed shop drawings indicating door and frame elevations, dimensions and sections, material thickness, swing, core construction, type and location of reinforcements. Show location and details of all openings and door accessories.
 - .2 Provide technical product data for all door hardware and glazing requirements.
- .3 Test Report: from independent testing laboratory indicating that door and frame assembly meets performance requirements of Clause 1.4.1 for grade of door specified.
- .4 Compliance Documentation: indicating compliance with quality assurance requirements specified in clause 1.5.

1.5 PERFORMANCE REQUIREMENTS

- .1 Door and door frame shall meet the performance criteria and test values obtained for Grade 3 door assembly as specified in HMMA 863 for the following tests:
 - .1 Door Assembly Impact Test to ASTM F1450
 - .2 Door Static Load Test to ASTM F1450
 - .3 Door Rack Test to ASTM F1450
 - .4 Door Edge Crush Test to ASTM F1450

1.6 QUALITY ASSURANCE

- .1 Manufacturer shall provide evidence of:
 - .1 Having personnel and plant equipment capable of fabricating hollow metal door and frame assembly of type specified and to construction methods and details indicated, including compliance with RCMP approved shop drawing details.
 - .2 Have written quality control program in place at Plant.
 - .3 Using Plant fabrication methods and product quality which meets standards set by the Hollow Metal Manufacturers Association, HMMA5, A Division of the National Association of Architectural Metal.

- .2 Site Installers shall be factory trained and approved by cell door manufacturer, having minimum 5 years previous work experience in cell door installations and capable of meeting door and frame site installation clearances and tolerances specified.

2.0 PRODUCTS

2.1 MATERIALS

- .1 Base Steel - hot dipped, commercial quality, paintable galvanneal steel, or G90 (Z275) steel.
- .2 Cell Doors - complete with Vision Ports, Food Pass, and other associated parts and function, Frames, Tracks as shown on standard drawings and details bound with specification.
 - .1 Notwithstanding details provided which may in some instances be diagrammatic fabricate all components with tolerances to the standards of Detention Cell Doors, and specific dimensions shown in documents and specifically the length of Cell door track and cover shown in the detail drawings appended to this specification. Obtain clarification of any issues relating to current standards by contacting the Project Manager with allowance for responses in accordance with the conditions outlined in the instructions to bidders. Pay careful attention to dimensions and clearances shown on the drawings for this project.
 - .2 Door construction to include 12 gauge top and bottom end channels continuously welded to door skins. Provide a minimum of 2 intermediate vertical frames, and trimming frames where continuity is broken from head to sill.
 - .3 Suitably space to accommodate openings, hinges and lock elements, complete with a pattern of horizontal framing members spaced with layout to suit openings and generally maximum spaces 344 mm, all welded at joints and to door faces of sheet steel, to provide strength and stiffness in both directions.
 - .4 Solid fill core with fibreboard insulation for sound attenuation. Face sheeting of doors to be minimum 14 Ga. if core framing as above otherwise increased in thickness to 12 Ga. for wider frame spacing.
 - .5 Fully weld door construction with no visible seams on faces, vertical edges, top and bottom or perimeter openings for pass through and door vision port. All welds to be finish smooth and unnoticeable. Grind all sharp corners.
 - .6 Doors prepared for key operated lock, keyed one side. Prepare door for and supplied with a 150 mm x 400 mm Lexan View Lite complete with Operable Viewport Shutter and Food Pass Flap equal to CP Distributors 100 Series Sliding Cell Doors.
 - .7 Door to be prime painted in ship and touch up primer will be applied on site if necessary.

.3 Cell Door Frames

- .1 Cell door frames shall be 12 Gauge wipecoat galvanized steel, mortised to accept security strike. Frame prepared for correct anchoring system compatible with the wall type.
- .2 Door frames to have mitred corners and be welded continuously along inside of door frame profile. All welds to be finish smooth.
- .3 Jambs, headings, sills and center rails are to be straight and rigid throughout lengths.
- .4 Frame profile, throat and width are manufactured to suit the location wall construction.
- .5 Field shimming on site may be necessary to meet desired clearances.
- .6 All exposed parts to be primed painted in shop, and touch up primer on site if necessary .

.4 Track Sets

- .1 Track Sets shall be fabricated from 10 ga. Steel.
- .2 Completed track set shall be primer painted in shop and then touch up paint applied on site if necessary.
- .3 Track set to be site welded to door frame at 8" on center.
- .4 Distance between door and frame once door is on track set is to be limited to 3mm.
- .5 Rollers minimum 95 mm diameter, turned from solid stock high alloy steel with friction hardened steel bearing with permanent lubrication, eccentric bushing for adjustment and self-locking nut. Rollers are to accept solid steel square track, and be removable for service and maintenance purposes.
- .6 Fully weld door hanger and guide to door at factory to ensure consistent alignment.

.5 Locks:

- .1 Mechanical locking: deadlocks and unlocks by key. Key is removable in both locked and unlocked condition.
- .2 Heavy-duty, five spring-temper brass tumbler paracentric deadlock. Activated by heavy phosphor-bronze springs. Precision fit to locking fence.
- .3 Large solid hook-bolt – zinc plated, hardened steel, 12mm (1/2") thick. Bolt movement 16mm (5/8").

- .4 Investment-cast key cylinder – one-piece bronze alloy with paracentric keyway.
- .5 Ductile iron case with 5mm (3/16") thick steel cover.
- .6 All working parts shall be corrosion resistant.
- .7 Finish – Zinc plated.
- .8 Install locks during fabrication of the door assembly, and adjust as required onsite for proper operation.
- .9 Keying: All keying factory registered with detention systems and correspond with the Detachment Name or Locations as the reference. A total of three keys per project supplied. All locks are to be keyed alike.
- .10 Approved Sliding Door Lock Model:
 - .1 Folger Adam 32D. No Substitutions permitted.
- .6 Food Pass Through
 - .1 Food pass with reinforced perimeter openings. Construct of 14 gauge steel.
 - .2 Fully weld in place to end channels of pass frame.
 - .3 Include continuous 50mm piano hinge welded to frame.
 - .4 Spring style non-keyed locking latch concealed within the door, and fastened to door plate with four (4) 8mm (5/16") flat head screws.
 - .5 Rubber bumper stops shall be installed at each end of channel.
- .7 View Port
 - .1 Fabricate sliding shutter of 12 gauge stainless steel plate.
 - .2 Top and bottom of slider frame to be coated with Teflon to ease in operation of slider.
 - .3 Glazing profile shall be
 - .1 6mm (1/4") Margard, notched to be flush with the door skin;
 - .2 6mm (1/4") spacer, (to prevent contact between glazing lites);
 - .3 6mm (1/4") polycarbonate glazing.
 - .4 Fasteners shall be 6mm (1/4") - #20 security screws.

- .5 Slider door handle shall be stainless steel fabrication, attached with two 6mm (1/4") #20 security screws.

.8 Door Receiver

- .1 Fabricated from 10 gauge steel.
- .2 Door receiver is to be notched back at 45 degrees to door frame to prevent
- .3 Install door receiver on site with a maximum 3mm (1/8") distance between door and frame.
- .4 Door receiver shall be plug-welded to the door frame and tack welded 12mm (1/2") every 203mm (8").

.9 Accessories:

- .1 Fasteners: all screws shall be flathead undercut Torx Tamperproof screws, security nuts or other secure devices for the installation of sliding cell door and frame assembly, Vision Ports in walls and cell doors and CCTV vision ports, all in accordance with design standards shown and to comply with latest standards of the RCMP. Screws supplied compatible with the material they are fastening as well as the material they are securing into. Two of each size bit supplied with the contract.

.10 Shop Applied Primer

- .1 Epoxy prime all exposed parts (except stainless steel elements) at factory using two part epoxy primer. Maintain same touch up primer on site for touch up areas damaged during installation and areas damaged by welding. Install door view port and slider in factory to ensure smooth running.

3.0 INSTALLATION

3.1 SITE STORAGE

- .1 Store doors and frames on site to protect against damage and stack to prevent warpage in accordance with manufacturer's recommendations and to HMMA 863 requirements.

3.2 DOOR INSTALLATION

- .1 Install cell doors, frames, hardware and accessories to HMMA 863 Guide Specifications, manufacturer's recommendations and to installation details and clearance requirements indicated on the RCMP Hollow Metal Door & Pressed Steel Frame Shop Drawings for Sliding and Swinging Cell Doors are pertinent for sliding doors.

- .2 Use only experience workers meeting quality assurance requirements of clause 1.5.2.
- .3 Set door and frame plumb, square, level and at correct elevation and alignment. Install to clearances and tolerances specified and as detailed. Take appropriate measures not to create installation tolerance buildup during the process.
- .4 Secure anchorages and connections to adjacent construction.
- .5 Brace frames rigidly in position while building-in.
- .6 Fill interior cavities behind door frames with masonry grout.
- .7 Maintain specified clearances between door and frame and between door and track/floor assembly.
 - .1 Provide metal shims where required.
- .8 Adjust operable parts for correct function.
- .9 Caulk perimeter of frames, projections and all crevices between door frame and wall with pick-proof epoxy sealant.

3.3 FINISH REPAIRS

- .1 Touch up surfaces of door and frame damaged or scratched during installation by use of zinc rich primer.
- .2 Fill exposed frame surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.
- .3 Prepare doors and frames to receive paint finish.

END OF SECTION

PART 1 GENERAL

1.1 WORK INCLUDED SUPPLY ONLY OF:

- .1 Acoustic steel frames.
- .2 Acoustic wood and steel doors, swing type.
- .3 Door gasketing along perimeter jambs & header.
- .4 Door bottom gasketing and threshold
- .5 Acoustic glazing (if required).

1.2 RELATED WORK

- .1 Rough Carpentry Section 06 10 00
- .2 Flush Wood Doors Section 08 14 16
- .3 Metal Doors and Frames Section 08 11 13
- .4 Door Hardware – Common Requirements Section 08 71 00
- .5 Non-structural Metal Stud Framing Section 09 22 16
- .6 Painting Section 09 91 10

1.3 REFERENCES

- .1 ASTM A480/A480M-06b - General Requirements for Flat-Rolled Stainless Heat-Resisting Steel Plate, Sheet, and Strip.
- .2 ASTM A653/A653M-06 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .3 ASTM E90-04 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .4 ASTM E413-04 - Classification for Rating Sound Insulation.
- .5 CSDMA Selection and Usage Guide for Steel Doors and Frames, 1990.
- .6 HMMA 802-92 - Manufacturing of Hollow Metal Doors and Frames.
- .7 HMMA 840-99 - Installation and Storage of Hollow Metal Doors and Frames.
- .8 NFPA 80-07 - Standard for Fire Doors and Other Opening Protectives.

- .9 UL 10C-98 - Standard for Positive Pressure Fire Tests of Door Assemblies.
- .10 ANSI/WDMA I.S. 1A-2004 - Industry Standard for Architectural Wood Flush Doors.
- .11 ANSI/ICC A117.1-2003 - Standard for Accessible and Usable Buildings and Facilities.

1.4 PERFORMANCE REQUIREMENTS

- .1 Acoustic Performance: Minimum Sound Transmission Class (STC) 50 tested to ASTM E9.
- .2 Installed Door and Frame Assembly to conform to ANSI/ICC A117.1.

1.5 SUBMITTALS

- .1 Section [01 33 00]: Submission procedures.
- .2 Shop Drawings: Indicate door and frame elevations, anchor types and closure methods, finishes location of cut-outs for hardware and cut outs for glazing where applicable.
- .3 Samples: Submit manufacturer's door finish samples, showing range of colour variation, manufacturer's frame corner sample, as well as perimeter acoustic gasket.
- .4 Test Data: Submit test data indicating compliance with the Sound Transmission Class (STC) requirements. Include laboratory name, test report number, and date of test.
- .5 Installation Instructions: Submit manufacturer's installation instructions.

1.6 QUALITY ASSURANCE

- .1 Perform work to requirements of CSDMA (Canadian Steel Door Manufacturers Association) HMMA (Hollow Metal Manufacturers Association) WDMA (Window and Door Manufacturers Association) standards.
- .2 Manufacturer: Minimum 5 years documented experience manufacturing acoustic wood door and frame assemblies.
- .3 Pre-installation Meeting: Convene a pre-installation meeting 2 (two) weeks before start of installation of door and frame assemblies. Require attendance of parties directly affecting work of this section, including contractor, Departmental Representative, installer, and manufacturer's representative. Review installation and coordination with other work.

1.7 DELIVERY, STORAGE AND PROTECTION

- .1 Section [01 61 00]: Transport, handle, store, and protect products.
- .2 Comply with WDMA I.S. 1A for wood doors.
- .3 Comply with HMMA 840 for steel frames.
- .4 Weld minimum two temporary jamb spreaders per frame prior to shipment.
- .5 Remove frames from wrappings or coverings upon receipt on site and inspect for damage. Leave doors covered for protection until hung.
- .6 Store doors in horizontal position, frames in vertical position, spaced with blocking to permit air circulation between components.
- .7 Store materials out of water and covered to protect from damage. Use covering that allows air circulation and does not permit light to penetrate.
- .8 Store doors between 50 to 90 degrees F (10 to 32 degrees C) and 25 to 55 percent relative humidity.
- .9 Clean and touch up scratches or disfigurement to metal surfaces on frame or wood surfaces on door.

1.8 WARRANTY

Material and workmanship shall be warranted by manufacturer for a period of five (5) years from the date of supply. Warranty shall apply to replacement or retrofit of product only.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

- .1 Acoustic Wood and Steel Doors

Ambico Limited
1120 Cummings Avenue
Ottawa, Ontario, Canada, K1J 7R8
Phone (613) 746-4663 / Fax (613) 746-4721
Toll Free Phone (North America): 888 423-2224
Toll Free Fax (North America): 800 465-8561

No Substitutions.

Supplied by Coastal Door and Frame
Dartmouth, N.S, Phone: 1-902-468-2333

2.2 MATERIALS

.1 Steel Frames

- .1 Steel commercial grade zinc coat steel to ASTM A653/A653M, ZF180, ZF75. Frames shall be 1.6mm thickness.
- .2 Primer: Rust inhibitive zinc chromate used for touch-up only.

.2 Wood Doors

- .1 Acoustic Core with wood face veneer to meet the standards of Section 08 14 10 (Wood Flush Doors). Visible stiles and rails shall be matching to the species of the face veneer.
- .2 All tolerances shall be in compliance with ANSI/NWWDA.

.3 Metal Doors

- .1 Steel facing to meet standards of Section 08 11 13 (Metal Doors and Frames); separated by a core construction designed to meet the required STC; and tested and rated in accordance with ASTM E90; flush seamless face sheets and vertical edges, with continuous welded and smooth joints. Provide edges that are flush or rabbeted as required for perimeter seals.
- .2 Acoustic core construction, longitudinal edges, mechanically inter-locked with visible edge seams.
- .3 Reinforcement: To CSA G40.20/G40.21, coating designation to ASTM A653/A653M, ZF75.
- .4 All tolerances shall be in compliance with ANSI/NWWDA.

2.3 ACCESSORIES

- .1 Hinges: Heavy weight butt type by Section 08 71 10
- .2 Glazing stops for frames: Formed galvanized steel channel, butted corners; prepared for countersink tamperproof screws for side lite and borrowed lite frames.
- .3 Glazing stops for doors: Formed stainless blade stops, mitred corners; prepared for countersink tamperproof screws.
- .4 Glass: Type as tested to achieve STC and fire ratings. Glazing to be factory supplied and pre-installed.
- .5 Primer: Rust inhibitive zinc chromate on frames.
- .6 Threshold: To provide a seal for door in closed position.
- .7 Astragal: To be supplied loose ready for field assembly by others
- .8 Perimeter and bottom acoustic seals: to provide an acoustic seal for door in closed position.

2.4 FABRICATION

- .1 Doors:
 - .1 Fabricate doors to ANSI/WDMA IS1A. Provide suitable thickness, design, and core to achieve specified STC and fire performance ratings.
 - .2 Reinforce doors where surface-mounted hardware is required.
 - .3 Drill and tap for mortised, templated hardware.
 - .4 Astragals: Metal acoustic astragals with integral acoustic seals for double doors.
 - .5 Exit Device Vertical Rods: coordinate door fabrication with exit hardware devices specified in Section 08 71 10.
- .2 Frames, Welded Type:
 - .1 Sheet steel, metal thickness and appropriate to maintain door STC and fire ratings, mitred corners, fully welded seams.
 - .2 Factory assemble and weld frames.
 - .3 Mullions for Double Doors (where applicable): Removable type.
 - .4 Factory install glazing. The acoustic level of the glass shall conform to that of the door/frame unit.

- .5 Affix permanent metal nameplates to door and frame, indicating manufacturer's name, and STC rating. Note that where concealed vertical rod exit devices are required, the door thickness will be 2 1/8" (53mm) to accommodate the acoustic structure necessary for reinforcement of the door hardware.

2.5 FINISHES

- .1 Metal Frame Finish: factory applied zinc chromate primer.
- .2 Factory Door Finish: Catalyzed polyurethane, premium grade, TR-6 finish to WDMA I.S.1A. Clear coat only.
- .3 Top and Bottom Rails: Factory sealed with wood sealer.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install components to manufacturer's written instructions.
- .2 Install wood doors and frames to ANSI/WDMA IS 1A standards, and in accordance with NFPA 80, and local authority having jurisdiction.
- .3 Utilize welders certified by Canadian Welding Bureau (CWB) for field welding of frame.
- .4 Coordinate with wall construction for anchor placement.
- .5 Set frames plumb, square, level and at correct elevation.
- .6 Allow for deflection to ensure that structural loads are not transmitted to frame.
- .7 Adjust operable parts for correct clearances and function.
- .8 Install and adjust perimeter and bottom acoustic seals.
- .9 Finish paint in accordance with Section 09 90 00.

3.2 ERECTION TOLERANCES

- .1 Installation tolerances of installed frame for squareness, alignment, twist and plumbness are to be no more than $\pm 1/16$ in (1.5mm)

3.3 FIELD QUALITY CONTROL

- .1 Provide qualified manufacturer's representative to instruct installers on the proper installation and adjustment of door assemblies.
- .2 Provide manufacturer's representative to inspect door installation, and test minimum ten (10) cycles of operation. Correct any deficient door and frame assemblies, as to meet the minimum STC required for the assembly.
 - .1 Set frames plumb, square, level and at correct elevation in accordance with manufacturer's installation instructions.
 - .2 Fire labeled frames shall be installed in accordance with NFPA-80, most current edition.
 - .3 Secure anchorages and connections to adjacent construction.
 - .4 Make allowance for deflection to ensure structural loads are not transmitted to frame product.
 - .5 Install doors and hardware in accordance with hardware templates and manufacturer's instructions

END OF SECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

- .1 Supply and install overhead sectional doors as herein specified and detailed on drawings.
- .2 Related work specified elsewhere:
 - .1 Miscellaneous Metals - Steel Channel Door Frames - Section 05 50 00
 - .2 Painting Section 09 91 10
 - .3 Electrical Division 26.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with General Conditions.
- .2 Clearly indicate opening sizes, details of door unit, track and hardware, attachments, related adjacent work, materials and finishes.

1.3 GUARANTEE

- .1 Provide a written 1 year guarantee from date of Substantial Completion against faulty materials (warping), workmanship and installation. All defects shall be replaced and repaired at no cost to the Department Representative.

1.4 RELATED WORK

- .1 Opening preparation, miscellaneous or structural metal work, access panels, finish or field painting, field electrical wiring, wire, conduit, fuses and disconnect switches are in the Scope of Work of other divisions or trades.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Standard of Acceptance is "Overhead Door Corporation - 422 Series" Insulated Sectional Steel Door or approved equal. Steelcraft Series "Thermo-Door 134" or Richard Wilcox Overhead Sectional Door Model T175 are pre-approved alternates. Deflection of door in the horizontal position will not exceed 1/120 of the door width. (Consult factory for unusual requirements.) **Note: Neoprene noise isolation hangers required on mounting brackets for track and motor.**
Size shall be suitable for a clear opening width of 3050 mm (10'-0") x 2700 mm (8'-10") high (Secure Bay); and 4270mm (14'-0") x 2700mm (8'-10") high (Cold Storage Building). **Confirm all dimensions with Departmental Representative, and on site, prior to fabrication.**

- .2 Sectional Door Assembly:
 1. Panel thickness: 50mm (2")
 2. Exterior Surface: Ribbed
 3. Sheet Steel: Minimum 1.6mm (16 gauge) galvanized exterior, inside cover 20 gauge steel.
 4. Centre and End Stiles of 16 gauge steel.
 5. Standards Springs: 10,000 cycles.
 6. Reinforcing Provide vertical steel stiffeners at maximum 762mm o.c.
- .3 Finish: factory-applied baked-on polyester or epoxy coating.
- .4 Windload Design: ANSI/DASMA 102 standards and as required by Code.
- .5 Insulation: insulation will be composed of polyisocyanurate with R-Value of 11.69.
- .6 Track: rolled steel sections, 13 gauge, heavily galvanized, 76 mm (3") nominal size, low lift design. Continuous angle welded or bolted to jambs. Horizontals adequately reinforced with hanging rods for door size and weight. Locate to ensure door has an overlap of 100mm to wall on both sides of opening.
- .7 Counterbalance: Torsion spring on cross-header shaft including 'Posi-tension' drums. Galvanized lift cables with safety factor 8:1 spring wire stressed to give high cycle life.
- .8 Hardware: Full-floating hardened steel ball bearing rollers. 75 mm heavy industrial, 200,000 cycle, hardware. All attachment brackets, track brackets and all related components to be galvanized. Provide full perimeter weatherstripping.
- .9 Hinges: heavy duty, minimum of four per section, bolted and spaced at a maximum of 772mm o.c.
- .10 Fender Guards: to protect vertical tracks 76 mm x 1.5 metres (3" x 60"), galvanized.
- .11 Weather Strip: a compressible rubber seal shall be attached to the bottom bar to provide weather protection at the sill. Provide full perimeter weatherstripping to head and jambs.
- .12 Vibration Isolators: neoprene isolation hangers to motor and door tracks.
- .13 Operation: Overhead doors to be electrically operated with a chain driven manual override, equipped as follows:
 - .1 Heavy duty ½ hp electric side/wall mount motor.
 - .2 76 mm (3") heavy duty trolley type lift.
 - .3 High cycle springs rated at a minimum 100,000 cycles.
 - .4 Controls
 - A) Room 301:
Controlled by push button up-down switch mounted on the sidewall adjacent each of the overhead doors inside the garage only - location as shown on the floor plan. No exterior door control switch.
 - B) Room 201:

The secure bay overhead door shall have three (3) control points as follows:

- 1) Exterior post-mounted up-down control switch with proximity card reader to permit activation.
 - 2) Interior: Wall-mounted up-down control switch with proximity card-reader to permit activation.
 - 3) Room 133: Wall-mounted key-operated up-down switch.
- .5 Automatic reversing mechanism, reversing at no greater than 8 ounce vertical pressure, as well as two electric eyes (one horizontal, one at a 45° angle to detect protruding high bumper) with built-in timer. Door shall not close when electric eye senses the presence of an object. Timer will allow door to close automatically after electric eye senses all clear. Setting of timer to be approved by Departmental Representative. Timer can be locked out to keep door in open position.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install unit complete to manufacturer's written instructions.
- .2 Co-ordinate installation with related work.
- .3 Fit, align and adjust complete assembly level and plumb to smooth operation.
- .4 Install and adjust full perimeter weatherstripping and all hardware.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Aluminum doors and frames.
- .2 Vision glass and glass infill panels.
- .3 Door hardware.
- .4 Perimeter sealant.

1.2 RELATED SECTIONS

- .1 Section 05 50 00 - Structural Steel: Steel fabricated attachment members.
- .2 Section 07 27 13 - Air and Air/Vapour Barriers: Perimeter air seal between glazing system and adjacent construction.
- .3 Section 07 84 00 - Firestopping: Fire stop at system junction with structure.
- .4 Section 07 92 00 - Joint Sealants: System perimeter sealant and back-up materials.
- .5 Section 08 71 00 - Door Hardware - General: Mortised hardware reinforcement requirements affecting framing members.
- .6 Section 08 42 29 - Automatic Door Operators.
- .7 Section 08 80 50 - Glass and Glazing.
- .8 Section 08 44 13 - Glazed Aluminum Curtain Walls.

1.3 REFERENCES

- .1 AA (Aluminum Association) DAF 45-2003 - Designation System for Aluminum Finishes.
- .2 AAMA CW-10-04 - Care and Handling of Architectural Aluminum from Shop to Site.
- .3 AAMA 501-05 - Methods of Test for Exterior Walls.
- .4 AAMA 501.1-05 - Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure.
- .5 AAMA 611-98 - Voluntary Specifications for Anodized Architectural Aluminum.
- .6 AAMA 2603-02 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
- .7 AAMA 2605-05 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- .8 AAMA RPC-00 - Rain Penetration Control.

- .9 AAMA SFM-1-87 (Reissued 2002) - Aluminum Store Front and Entrance Manual.
- .10 ASTM B209M-07 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .11 ASTM B221-08 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- .12 ASTM E330-02(2010) - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- .13 ASTM E1105-00 (2008) - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
- .14 CAN/CGSB 1.40-97 - Anticorrosive Structural Steel Alkyd Primer.
- .15 CAN/CGSB 1.181-99 - Ready-Mixed Organic Zinc-Rich Coating.

1.4 SYSTEM DESCRIPTION

- .1 Aluminum entrances and storefront system includes tubular aluminum sections with supplementary internal support framing, shop fabricated, factory finished, vision glass, glass infill, related flashings, anchorage and attachment devices.
- .2 System Assembly: Site assembled.

1.5 PERFORMANCE REQUIREMENTS

- .1 System Design: Design and size components to withstand dead loads and live loads caused by positive and negative wind loads acting normal to plane of wall as measured in accordance with ASTM E330.
- .2 Deflection: Limit mullion deflection to 1/200 of span; with full recovery of glazing materials.
- .3 System Assembly: Accommodate without damage to components or deterioration of seals, movement within system, movement between system and peripheral construction, dynamic loading and release of loads, deflection of structural support framing.
- .4 Air Infiltration: Limit air leakage through assembly to 0.0003 cu m/s sq m of wall area, measured at a reference differential pressure across assembly of 75 Pa as measured in accordance with ASTM E283.
- .5 Air and Vapour Seal: Maintain continuous air barrier and vapour retarder throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound.
- .6 Vapour Seal: Limit vapour seal with interior atmospheric pressure of 25 mm sp, 22 degrees C, 40 Percent RH without seal failure.
 - .1 (OR)

- .7 Expansion / Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 95 degrees C over a 12 hour period without causing detrimental effect to system components and anchorage.
- .8 System Internal Drainage: Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to the exterior by a weep drainage network.

1.6 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the Work with installation of air/vapour barrier components or materials.
 - .3 Pre-Installation Meeting: Convene one (1) week before starting work of this section.

1.7 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware and internal drainage details.
- .3 Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work and expansion and contraction joint location and details.

1.8 CLOSEOUT SUBMITTALS

- .1 Section 01 78 10: Submission procedures.
- .2 Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in Department Representative's name and registered with manufacturer.

1.9 QUALITY ASSURANCE

- .1 Conform to requirements of NBCC code for accessibility.
- .2 Installer: Company specializing in manufacturing aluminum glazing systems with minimum three (3) years documented experience.
- .3 Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the place where the Project is located.

1.10 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.

- .2 Handle Products of this section in accordance with AAMA CW-10.

1.11 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 26: Environmental conditions affecting products on site.
- .2 Do not install sealants when ambient temperature is less than 5 degrees C during and 48 hours after installation.

1.12 WARRANTY

- .1 Section 01 78 10: Warranties.
- .2 Correct defective Work within a four (4) year period after Substantial Completion.
- .3 Warranty: Include coverage for complete system for failure to meet specified requirements.
- .4 Provide four (4) year extended warranty for glazed units.

Part 2 Products

2.1 MANUFACTURERS

- .1 Framing Manufacturer
 - .1 Kawneer; Product: 451 and 451T.
 - .2 Other acceptable manufacturers offering functionally and aesthetically equivalent products.
 - .3 Alumicor; Product: TL 1800 and BF 3400.
 - .4 AD Prevost; Product: 40 Series and 65 Series.
- .2 Door Manufacturer
 - .1 Kawneer Product: 350 Medium Stile Entrance
 - .2 Same as manufacturer offering functionally and aesthetically similar product.

2.2 GLASS AND GLAZING MATERIALS

- .1 Glass and Glazing Materials: As specified in Section 08 80 50.

2.3 SEALANT MATERIALS

- .1 Sealant and Backing Materials:
 - .1 Perimeter Sealant: Type as specified in Section 07 92 00.
 - .2 Sealant Used Within System (Not Used for Glazing): Type as specified in Section 07 92 00.

2.4 HARDWARE

- .1 Coordinate hardware supplied by 08 71 00 and installed by this contractor.

2.5 FABRICATION

- .1 Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- .2 Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.
- .3 Prepare components to receive anchor devices. Fabricate anchors.
- .4 Arrange fasteners and attachments to conceal from view.
- .5 Reinforce interior horizontal head rail to receive blind track brackets and attachments.
- .6 Prepare components with internal reinforcement for door hardware and door operator hinge hardware.
- .7 Reinforce framing members for imposed loads.

2.6 FINISHES

- .1 Clear Anodic Coating: Class I, AA-M12C22A41.
 - .1 Location: Exterior exposed aluminum surfaces.
 - .2 Location: Interior exposed aluminum surfaces.
- .2 Apply two (2) coats of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.
- .3 Shop and Touch-Up Primer for Steel Components: CAN/CGSB-1.40.
- .4 Touch-Up Primer for Galvanized Steel Surfaces: CAN/CGSB-1.181.
- .5 Extent of Finish:
 - .1 Apply factory coating to all surfaces exposed at completed assemblies.
 - .2 Apply finish to surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
 - .3 Apply touch-up materials recommended by coating manufacturer for field application to cut ends and minor damage to factory applied finish.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify dimensions, tolerances, and method of attachment with other work.
- .3 Verify wall openings and adjoining air and vapour seal materials are ready to receive work of this Section.

3.2 INSTALLATION

- .1 Install wall system in accordance with AAMA CWG-1.

- .2 Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- .3 Provide alignment attachments and shims to permanently fasten system to building structure.
- .4 Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- .5 Provide thermal isolation where components penetrate or disrupt building insulation.
- .6 Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- .7 Coordinate attachment and seal of perimeter air and vapour barrier materials.
- .8 Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- .9 Install flashings and seal to a/v barrier.
- .10 Set thresholds in bed of mastic and secure.
- .11 Install hardware using templates provided. Refer to Section 08 71 00 for installation requirements.
- .12 Install glass and infill panels in accordance with Section 08 80 50, to glazing method required to achieve performance criteria.
- .13 Install perimeter sealant to method required to achieve performance criteria.

3.3 ERECTION TOLERANCES

- .1 Section 01 73 00: Tolerances.
- .2 Maximum Variation from Plumb: 1.5 mm/m non-cumulative or 1.5 mm per 3 m , whichever is less.
- .3 Maximum Misalignment of Two Adjoining Members Abutting in Plane: 0.8 mm

3.4 FIELD QUALITY CONTROL

- .1 Section 01 45 00: Field adjusting.
- .2 Inspection will monitor quality of installation and glazing.
- .3 Test to ASTM E1105.

3.5 ADJUSTING

- .1 Adjust operating hardware and sash for smooth operation.

3.6 CLEANING

- .1 Section 01 74 00: Cleaning installed work.
- .2 Remove protective material from pre-finished aluminum surfaces.

- .3 Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- .4 Remove excess sealant by method acceptable to sealant manufacturer.

3.7 PROTECTION OF FINISHED WORK

- .1 Section 01 78 40: Protecting installed work.
- .2 Protect finished Work from damage.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

- .1 The work of this section includes the furnishing of all labour, materials and equipment for the supply and installation of all automatic swinging aluminum door electro-mechanical operators and hardware.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- .1 Related work specified elsewhere:
- | | | |
|----|---------------------------|------------------|
| .3 | Aluminum Framed Entrances | Section 08 41 13 |
| .4 | Door Hardware | Section 08 71 00 |
| .5 | Electrical work | Division 26 |
- Electrical contractor shall provide 115 V 60 cycle, 1 phase service to operator junction box. Service to be 5 amp. for operators.

1.3 STANDARDS

- .1 Standard of Acceptance:
- .1 Nabco Entrances Inc. Gyro Tech GT710
 - .2 Assa Aldoy Sargent M300 or M4000.
 - .3 Rixon 2900 Series.
- .2 The automatic door system shall be completely engineered, manufactured and assembled by manufacturer. All operator components shall be factory assembled, adjusted and tested. No field wiring or operator adjustment shall be required other than the connection to job-site power. Operating equipment shall be electro-mechanical with electric power open. No hydraulic equipment allowed.
- .3 All automatic entrance equipment is to comply with the requirements of the American National Standard for Power Operated Pedestrian Doors, ANSI A156.19, UL325 and CAN/CSA-C22.2 No. 247-92 standards.
- .4 Installation shall be by an installer approved and trained by the manufacturer in strict accordance with manufacturer's instructions and fire marshall's listing requirements. Provide a label on the equipment listing the company name and phone number for service.

1.4 SHOP DRAWINGS AND SAMPLES

- .1 Submit printed literature and photographic descriptions of all extrusions, hardware, etc. to indicate style, profiles, size and finishes.
- .2 Submit shop drawings in accordance with General Conditions.
- .3 Clearly indicate, by large scale details, all perimeter conditions of the assembly, anchorage, sealing techniques, tolerances of openings, and elevations, all materials and finishes.
- .4 Provide all necessary wiring diagrams and all data necessary for proper preparation and interface connections by other trades.

1.5 DELIVERY AND STORAGE

- .1 Deliver and store all materials in accordance with manufacturer's directions.
- .2 Comply with all other manufacturer's instructions regarding care and installation of materials to fulfil guarantee requirements.
- .3 All materials to be properly packaged for protection during transit and onsite handling.

1.6 WARRANTY

- .1 Provide a manufacturer's written warranty against defective material and workmanship which may appear within a period of one (1) year from Departmental Representative's Certificate of Substantial Completion. During the warranty period the Department Representative shall request NABCO factory-trained technicians to perform service. Replace all defective material including any and all damage to other material or surfaces to the satisfaction of and at no cost to the Department Representative.

PART 2 PRODUCTS

2.1 SYSTEM OPERATION

- .1 Hydraulic Close operator shall open door by energizing motor and shall stop by stalling motor against mechanical stop. Door shall close slowly by means of an adjustable hydraulic closer independent of the motor and electric control. Closing speed shall be fully adjustable. Manual door operation shall require less than 15 pounds of force applied to door stile. System shall also operate as a manual door in event of a power failure. Hold open time shall be adjustable from 1-60 seconds.
- .2 The system must operate between -34 degrees C and 71 degrees C

2.2 EQUIPMENT

- .1 Operator Housing for the GT710 shall be 146 mm (5 3/4") deep by 152 mm (6") high aluminum extrusion with finished end caps and shall be prepared for

mounting to new or existing door frames. Housing cover shall be removable to provide service access. Plastic covers shall not be acceptable.

- .2 All structural sections shall have a minimum thickness of 4 mm (.166") and shall be fabricated of 6063-T5 aluminum alloys. Housing cover shall be removable to provide service access and shall be extruded from 6063-T5 aluminum alloys to a minimum thickness of 3mm (.100"). Plastic covers shall not be acceptable.
- .3 Power Operator completely assembled unit shall include silent bevel gear and roller chain transmission. Gears and chain coated with a special lubricant for extreme temperature conditions. Closer to be an adjustable self- contained, sealed, spring/hydraulic unit. Attached to the transmission system shall be a DC permanent magnet motor. Motor shall operate from electronic control and require less than 3 amps at full power stall. Complete unit shall be mounted with provisions for easy replacement without removing door from pivots or frame. Door operator to include integral door stop with variable positions.
- .4 Electrical Control: Shall be a solid-state microprocessor unit. The microprocessor control shall allow the opening speed, closing speed, back check and latch check speed each to be adjusted separately and independently from each other to meet specific site conditions. Adjustable opening and closing speeds shall be set in accordance with ANSI A156.19. Control shall include time delay, Push-N-Go circuitry and sequential mode operation. All adjustments shall be specific and reproducible.
- .5 Connecting Hardware: Conversion Unit (C.U.) outswing doors shall be connected to operator by a two piece drive arm with self aligning rod ends and connecting door bracket for push-type operation. Inswing drive arm with a urethane covered roller, shall ride in a track fabricated of 6061-T6 or A380 aluminum alloy attached to the door rail where required for pull-type operation. Overhead Concealed (OHC) power operator drive arm to door with a pin linkage rotating in a self lubricated bearing, within a self adjusting slide block, traveling in an interconnected steel track and top door pivot assembly. The (OHC) unit will independently support the door on heavy-duty steel top and bottom door pivots. To allow for durability and easy serviceability, the door shall not pivot on shaft of operator.

2.3 HEADER

- .1 The header shall be extruded aluminum 146 mm wide x 152 mm high to meet the architectural site line requirement of the storefront and jambs. As only a single leaf in the double set of doors is automatic, carry the header box across the head of all doors to present a balanced appearance.
- .2 When the header is mounted between the jambs over the door, the door arm must be completely concealed in the top rail of the door.
- .3 For an uncluttered sight line the header shall mount approximately 3 mm from the top rail of the door without the use of an intermediate strip between the header and the top rail of the door.

The header shall be provided with a finish to match aluminum doors, entrances and screens specified in Section 08 41 13.

2.4 CLOSERS

- .1 Provide a closer to single door or to each leaf of pairs of doors. Closers shall be concealed within the header box, shall be to the standards of Section 08 71 00, and shall be coordinated with that Section.

2.5 ACTIVATING DEVICES

- .1 Wall Switches: 113 mm square stainless steel surface mounted, engraved with universal handicap symbol.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Automatic door equipment shall be installed by AAADM Certified, factory-trained installers in compliance with ANSI A156.19, manufacturer's recommendations and approved shop drawings.
- .2 The general contractor and aluminum entrance doors and screens contractor shall provide adequate support for the automatic door operators.
- .3 Inspection: the automatic door entrance installer must examine the areas and conditions under which the automatic entrances are to be installed and notify the general contractor in writing of conditions detrimental to the proper functioning of the entrance and the timely completion of the work. Do not proceed with the work until satisfactory conditions have been corrected in a manner acceptable to the installer.
- .4 Adjust: after repeated operation of the completed installation, readjust door operators and controls for optimum operating condition and safety.
- .5 Clean aluminum surfaces promptly after installation. Advise general contractor of protective treatment and other precautions required through the remainder of the construction period, to ensure that automatic entrances will be without damage or deterioration (other than normal weathering) at the time of acceptance.
- .6 Instruct Department Representative in proper care and maintenance of units.

Part 1 General

1.1 SECTION INCLUDES

- .1 Aluminum tube framing system with vision glass.
- .2 Glass infill panels.
- .3 Integral air barrier and vapour retarder.
- .4 Perimeter sealant.

1.2 RELATED SECTIONS

- .1 Section 05 50 00 - Structural Steel: Steel fabricated attachment members and framed openings.
- .2 Section 07 92 00 - Joint Sealants: System perimeter sealant and back-up materials.
- .3 Section 08 41 13 - Aluminum Framed Entrances and Storefronts: Entrance doors, frames, and glazed lights.
- .4 Section 08 71 00 - Door Hardware - General: Mortised hardware reinforcement requirements affecting curtain wall framing members.
- .5 Section 08 80 50 - Glass and Glazing.

1.3 REFERENCES

- .1 AA (Aluminum Association) DAF 45-2003 - Designation System for Aluminum Finishes.
- .2 AAMA CW-DG-1-96 (R2005) - Aluminum Curtain Wall Design Guide Manual.
- .3 AAMA CWG-1-89 (R2004) - Installation of Aluminum Curtain Walls.
- .4 AAMA CW-10-04 - Care and Handling of Architectural Aluminum from Shop to Site.
- .5 AAMA 501-05 - Methods of Test for Exterior Walls.
- .6 AAMA 611-98 - Voluntary Specifications for Anodized Architectural Aluminum.
- .7 ASTM B209-07 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .8 ASTM E283-04 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .9 CAN/CGSB 1.40-97 - Anticorrosive Structural Steel Alkyd Primer.
- .10 SSPC (The Society for Protective Coatings) - Steel Structures Painting Manual.

1.4 SYSTEM DESCRIPTION

- .1 Curtain Wall System: Tubular aluminum sections with supplementary support framing, factory prefinished, vision glass, glass spandrel infill; related flashings, anchorage and attachment devices.

- .2 System Assembly: Site assembled.

1.5 PERFORMANCE REQUIREMENTS

- .1 System Design: Design and size components to withstand dead loads and live loads caused by positive and negative wind loads acting normal to plane of wall, as measured in accordance with ASTM E330.
- .2 Seismic Loads: Design and size components to withstand seismic loads and sway displacement.
- .3 Deflection: Limit mullion deflection to flexure limit of glass with full recovery of glazing materials.
- .4 System Assembly: Accommodate without damage to system, components or deterioration of seals, movement within system, movement between system and perimeter framing components, dynamic loading and release of loads, deflection of structural support framing, tolerance of supporting components.
- .5 Air Infiltration: Limit air infiltration through assembly to 0.03 l/s/sq m of wall area, measured at a reference differential pressure across assembly of 300 Pa as measured in accordance with ASTM E283.
- .6 Vapour Seal: Limit vapour seal with interior atmospheric pressure of 22 mm sp, 22 degrees C, 40 percent RH without seal failure.
- .7 Expansion / Contraction: System to provide for expansion and contraction within system components caused by a cycling temperature range of 95 degrees C over a twelve (12) hour period without causing detrimental affect to system components.
- .8 System Internal Drainage: Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to the exterior by a weep drainage network.
- .9 Air and Vapour Seal:
 - .1 Maintain continuous air barrier and vapour retarder throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound.
- .10 Not Permitted: Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.

1.6 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination: Coordinate with other work having a direct bearing on work of this section.
 - .1 Coordinate the Work with installation of vapour retarder placement and air barrier placement components or materials.
- .3 Pre-Installation Meeting: Convene one (1) week before starting work of this section.

1.7 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details and water flow drainage.
- .3 Design Data: Provide framing member structural and physical characteristics, calculations, climatic data and dimensional limitations.
- .4 Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, anticipated deflection under load, affected related Work, weep drainage network, expansion and contraction joint location and details, and field welding required. Design data to be stamped by a Professional Structural Engineer licensed at the place where the Project is located.

1.8 QUALITY ASSURANCE

- .1 Perform Work in accordance with AAMA CW DG-1 - Metal Curtain Wall, Window, Store Front and Entrance - Guide Specifications Manual.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years documented experience.
- .3 Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience and approved by the manufacturer.
- .4 Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the place where the Project is located.

1.9 DELIVERY, STORAGE, AND PROTECTION

- .1 Handle work of this Section in accordance with AAMA CW-10.
- .2 Protect prefinished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather. Puncture wrappings at ends for ventilation.

1.10 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 26: Environmental conditions affecting products on site.
- .2 Do not install sealants when ambient temperature is less than 5 degrees C.
- .3 Maintain this minimum temperature during and after installation of sealants.

Part 2 Products

2.1 MANUFACTURERS

- .1 Alumicor; Product: Thermal Wall 2600.
- .2 Other acceptable manufacturers offering functionally and aesthetically equivalent products.

- .1 Kawneer; Product: 1600 UT.
- .2 AD Prevost; Product: 3400 HP.

2.2 MATERIALS

- .1 Extruded Aluminum: ASTM B221/B221M.
- .2 Sheet Aluminum: ASTM B209M.
- .3 Fasteners: stainless steel.

2.3 COMPONENTS

- .1 Mullion Profile: 50 mm nominal dimension for vertical members, 50 mm nominal dimension for horizontal members; thermally broken with interior tubular section insulated from exterior pressure plate;; matching stops and pressure plate of sufficient size and strength to provide bite on and infill panels; drainage holes, deflector plates and internal flashings to accommodate internal weep drainage system; internal mullion baffles to eliminate "stack effect" air movement within internal spaces.
- .2 Reinforced Mullion: 50 mm profile of extruded aluminum cladding with internal reinforcement of shaped steel structural section.
- .3 Operable Sash: awning style, removable screens, crank handle, two point latch hardware, by curtain wall manufacture.
 - .1 Performance details specified in Section 08 51 13.
- .4 Air/Vapour Barrier: Specified in Section 07 27 13.

2.4 GLASS AND GLAZING MATERIALS

- .1 Glazing Materials: As specified in Section 08 80 50.
- .2 Glazing Materials: Type to suit application to achieve weather, moisture, and air infiltration requirements.

2.5 SEALANT MATERIALS

- .1 Sealant and Backing Materials: As specified in Section 07 92 00 of Types described below.
 - .1 Perimeter Sealant: Type Silicone to match curtainwall colour.
- .2 Expanding Foam Insulation and Sealant: to Section 07 21 19, VOC compliant.

2.6 FABRICATION

- .1 Fabricate system components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal. Utilize deflection track framing where indicated or otherwise required by design.
- .2 Provide dead load anchors and clips to attach curtain wall assembly to floor slab and supporting structural steel; including suspended assemblies not bearing on foundations or footing.
- .3 Provide reinforcing steel within tubular extrusions where required by design.

- .4 Accurately fit and secure joints and corners. Make joints hairline and flush.
- .5 Prepare components to receive anchor devices. Fabricate anchors.
- .6 Arrange fasteners and attachments to ensure concealment from view.
- .7 Reinforce framing members for external imposed loads.
- .8 Aluminum Panels: Fabricate panels as extruded aluminum sheet laminated to plywood core using construction adhesive.

2.7 FINISHES

- .1 Clear Anodic Coating: AAMA 611, Class I, AA-M12C22A41.
 - .1 Location: Interior and exterior exposed aluminum surfaces.
- .2 Shop and Touch-Up Primer for Steel Components: SPCC Paint 25 red oxide.
- .3 Concealed Steel Items: Galvanized to ASTM A123/A123M, with 610 g/sq m coating thickness.
- .4 Apply one (1) coats of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify dimensions, tolerances, and method of attachment with other work.
- .3 Verify wall openings and adjoining air barrier and vapour retarder materials are ready to receive work of this section.

3.2 INSTALLATION

- .1 Install curtain wall system to manufacturer instructions.
- .2 Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- .3 Provide alignment attachments and shims to permanently fasten system to building structure.
- .4 Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances and align with adjacent work.
- .5 Provide thermal isolation where components penetrate or disrupt building insulation.
- .6 Install sill flashings.
- .7 Coordinate attachment and seal of perimeter air barrier and vapour retarder materials.
- .8 Foam fill shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- .9 Install operating sash glass in accordance with Section 08 80 50, to exterior wet/dry method of glazing.

- .10 Install glass and infill panels in accordance with Section 08 80 50, to glazing method required to achieve performance criteria.
- .11 Install perimeter sealant to method required to achieve performance criteria.

3.3 ERECTION TOLERANCES

- .1 Section 01 73 00: Tolerances.
- .2 Maximum Variation from Plumb: 1.5 mm/m non-cumulative or 12 mm/m, whichever is less.
- .3 Maximum Misalignment of Two Adjoining Members Abutting in Plane: 0.8 mm.
- .4 Sealant Space between Curtain Wall Mullions and Adjacent Construction: Maximum of 19 mm and minimum of 6 mm.

3.4 ADJUSTING

- .1 Adjust operating sash for smooth operation.

3.5 CLEANING

- .1 Section 01 74 00: Cleaning installed work.
- .2 Remove protective material from prefinished aluminum surfaces.
- .3 Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- .4 Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

3.6 PROTECTION OF FINISHED WORK

- .1 Section 01 78 40: Protecting installed work.
- .2 Protect finished Work from damage.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Extruded aluminum windows with fixed sash including infill panels.
- .2 Site glazed.
- .3 Operating hardware and insect screens.
- .4 Perimeter sealant.

1.2 RELATED SECTIONS

- .1 Section 06 11 00 - Wood Framing: Wood framed openings.
- .2 Section 06 10 13 - Wood Blocking and Curbing: Wood perimeter shims.
- .3 Section 07 27 13 - Air/Vapour Barriers: Perimeter air seal between window frame and adjacent construction.
- .4 Section 07 92 00 - Joint Sealants: Perimeter sealant and back-up materials.
- .5 Section 08 80 50 - Glass and Glazing.
- .6 Section 08 44 13 - Glazed Aluminum Curtain Walls: Operable sash within glazing system.

1.3 REFERENCES

- .1 AA (Aluminum Association) DAF 45-2003 - Designation System for Aluminum Finishes.
- .2 AAMA CW-10-04 - Care and Handling of Architectural Aluminum from Shop to Site.
- .3 AAMA 611-98 - Voluntary Specifications for Anodized Architectural Aluminum.
- .4 AAMA 1503-09 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections.
- .5 AAMA 2603-02 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
- .6 AAMA 2605-05 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- .7 ASTM B209M-07 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .8 ASTM B221M-07 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- .9 CAN/CGSB-79.1-M91 - Insect Screens.
- .10 CAN/CSA-A440.4-07 - Window, Door, and Skylight Installation.

- .11 CAN/CSA W59.2-[M1991(R2003)], Welded Aluminum Construction.
- .12 CAN/CSA-S157-[2005], Strength Design in Aluminum
- .13 CAN/CSA-Z91 - [M90(R2000)], Safety Code for Window Cleaning Operations.
- .14 CAN/ULC-S710.1 [2005], Standard for Thermal Insulation – Bead-Applied One Component Polyurethane Air Sealant Foam, Part 1: Materials Standard for Thermal Insulation - Bead - Applied One Component Polyurethane Air Sealant Foam, Part 1: Materials.

1.4 SYSTEM DESCRIPTION

- .1 Windows: Tubular aluminum sections, factory fabricated, factory finished, vision glass, infill panels related flashings, anchorage and attachment devices.
- .2 Configuration: several types of sash.
- .3 Glazing: Exterior.

1.5 PERFORMANCE REQUIREMENTS

- .1 Conform to AAMA/WDMA/CSA/101/I.S.2/A440, designation Fixed Window : FW-R15 and Awning, hopper, projected window, : AP-AW40.;
- .2 Vapour Seal: Limit vapour seal with interior atmospheric pressure of 25 mm sp, 22 degrees C, 40% RH without seal failure.
- .3 System Internal Drainage: Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to the exterior by a weep drainage network.
- .4 Air and Vapour Seal: Maintain continuous air barrier and vapour retarder throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound. Position thermal insulation on exterior surface of air barrier and vapour retarder.

1.6 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meeting: Convene one (1) week before starting work of this section.

1.7 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide component dimensions, anchorage and fasteners, glass, internal drainage details and STC rating and air tightness.
- .3 Shop Drawings: Indicate opening dimensions, framed opening tolerances, affected related work; installation requirements; and envelope and hardware details.

1.8 QUALITY ASSURANCE

- .1 Products of This Section: Manufactured to ISO 14000 certification requirements.
- .2 Perform Work to AAMA/WDMA/CSA-101/I.S.2/A440.

- .3 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.
- .4 Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience and approved by the manufacturer.

1.9 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.
- .2 Protect factory finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.

1.10 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 26: Environmental conditions affecting products on site.
- .2 Do not install sealants when ambient temperature is less than manufacturer's recommendations.
- .3 Maintain this minimum temperature during and after installation of sealants.

1.11 WARRANTY

- .1 Section 01 78 10: Warranties.
- .2 Correct defective Work within a four (4) year period after Date of Substantial Completion.
- .3 Provide four (4) year extended warranty for insulated glass units from seal failure, interpane dusting or misting, and replacement of same.
- .4 Warranty: Include coverage for degradation of colour finish.

Part 2 Products

2.1 MANUFACTURERS

- .1 Alumicor , Product Top Hinge Ultravent, 1400 Series
 - .1 standard hardware, fibreglass mesh screen and frame, scissor type roto-operator with locking handle
- .2 Other acceptable manufacturers offering functionally and aesthetically equivalent products.
 - .1 Kawneer; Product: Glassvent.
 - .2 AD Prevost; Product: 1400.

2.2 GLASS AND GLAZING MATERIALS

- .1 Glass and Glazing Materials: As specified in Section 08 80 50 of Types described below:

2.3 FABRICATION

- .1 Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- .2 Accurately fit and secure joints and corners. Make joints flush, hairline and weatherproof.
- .3 Prepare components to receive anchor devices. Fabricate anchors.
- .4 Arrange fasteners and attachments to ensure concealment from view.
- .5 Prepare components with internal reinforcement for operating hardware.
- .6 Permit internal drainage weep holes and channels to migrate moisture to exterior. Provide internal drainage of glazing spaces to exterior through weep holes.
- .7 Assemble insect screen frame, mitre and reinforced frame corners. Fit mesh taut into frame and secure. Fit frame with four (4), spring loaded steel pin retainers.
- .8 Double weatherstrip operable units.

2.4 FINISHES

- .1 Clear Anodic Coating: AA DAF-45-M12C22A44, Architectural Class I, clear.
 - .1 Location: Interior and Exterior exposed aluminum surfaces.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify wall openings and adjoining air and vapour seal materials are ready to receive work of this Section.

3.2 INSTALLATION

- .1 Install window frames, and hardware to manufacturer's written instructions.
- .2 Install window assembly to CSA-A440.4.
- .3 Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.
- .4 Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.
- .5 Install sill and sill end angles.
- .6 Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.

- .7 Coordinate attachment and seal of perimeter air barrier and vapour retarder materials.
- .8 Install operating hardware.
- .9 Install glass and infill panels as specified in Section 08 80 50, to glazing method required to achieve performance criteria.
- .10 Install perimeter sealant to method required to achieve performance criteria.

3.3 ERECTION TOLERANCES

- .1 Section 01 73 00: Tolerances.
- .2 Maximum Variation from Level or Plumb: 1.5 mm per m non-cumulative or 3 mm in 3 m, whichever is less.

3.4 ADJUSTING

- .1 Adjust hardware for smooth operation and secure weathertight closure.

3.5 CLEANING

- .1 Section 01 74 00: Cleaning installed work.
- .2 Remove protective material from factory finished aluminum surfaces.
- .3 Wash surfaces by method recommended and acceptable to sealant and window manufacturer; rinse and wipe surfaces clean.
- .4 Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant and window manufacturer.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

- .1 The work of this section includes the supply of the acoustical observation windows with manually operated adjustable louvers, as herein specified, and as show on drawings.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- | | | |
|----|-------------------------|------------------|
| .1 | Reinforced Unit Masonry | Section 04 26 19 |
| .2 | Rough Carpentry | Section 06 10 00 |
| .3 | Joint Sealants | Section 07 92 00 |
| .4 | Glass and Glazing | Section 08 80 50 |

1.3 PERFORMANCE

- .1 The product shall have been tested in accordance with Canadian Specification CAN2-12.8-M.76 with IGMAC Certification and ASTM E-773-81 "Standard Test Method for Seal Durability of Sealed Insulating Glass Units" and ASTM E-774-81 "Standard Specification for Sealed Insulated Glass Units", level CBA.

1.4 SUBMITTALS

- .1 Product Data: Descriptive data and performance attributes for vision control glass.
- .2 Installation Instructions: The installation of VISION CONTROL shall be executed in strict conformity with the approved shop drawings. These drawings shall clearly indicate complete installation details.
- .3 Maintenance Instructions: Manufacturer's printed instructions for cleaning and maintenance of glazed units, including operators.

1.5 SYSTEM DESCRIPTION

- .1 Control vision through glazed assemblies by means of rotating, cordless, interlocking, horizontal extruded aluminum louvers with rotation controlled manually. Rotation of louvers results in reduction in or elimination of vision through glazed assemblies. Unit to include insulated extruded aluminum frame suitable for installation in an interior concrete masonry wall. Unit shall be designed to achieve STC50 acoustic performance.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver and store glass units in upright position, on blocks, in dry and safe location.
- .2 Do not place units in direct sunlight.
- .3 Handle units using corner protectors.

1.7 WARRANTY

- .1 Vision Control Glass in Interior Locations: Furnish manufacturer's written ten (10) year warranty providing coverage against material obstruction of glass units by dust or film formation due to failure of hermetic seal.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Aluminum extrusions: Aluminum Association Alloy AA6063-T-5.
- .2 Fasteners: to manufacturer's standard for installation of glazed security barrier framing in masonry walls. Exposed glazing stop fasteners to be tamper resistant type.
- .3 Glass: materials to be in accordance with Section 08 80 50: Glass thickness shall be determined by the manufacturer according to application and sizes of glass units. At a minimum glass thicknesses shall be as follows:
 - .1 For the interior lite: 12mm laminated heavy strength glass consisting of two (2) layers of heat strengthened tempered glass and interlayer of .030 PVB.
 - .2 For the exterior lite: 6mm laminated heavy strength glass, consisting of two (2) layers of 3mm glass and interlayer of .060 PVB.
 - .3 Air space: 2-1/2" (63.5 mm)
- .4 Louvers:
The 1 3/8" (35 mm) louvers shall be made of extruded aluminum, hollow chambered profile with overlap, alloy 6063 T-5. The louvers shall be secured at both ends with molded pivots and shall operate without cords or strings. The louvers shall be mounted horizontally.
- .5 Spacers: The corrosion-resistant aluminum spacers of 2" (50.8 mm) shall be chemically cleaned and shall contain a sufficient quantity of desiccant. They shall be turned into frames by mechanically locked corner keys.
- .6 Operators: (Manual Operation)
 - .1 pivots, pinions, and racks shall be made of UV stabilized materials to ensure dimensional stability, durability, and maintenance-free service never needing lubrication.

- .2 The rotation of the blades shall be controlled through a manual knob type operator. The blades shall rotate 180 degrees in a continuous cycle. The axle of the mechanism shall be positioned at 6 3/8" (162 mm) from the bottom or the top of the panel, on the left or right side.
- .3 Operators shall be installed on one side (secure side) only.
- .4 Knob to be fully bonded to the operator shaft to prevent removal.

- .7 Sealant: Compressed polyisobutylene shall be used as a primary seal and high quality polysulfide as a secondary seal. The contact of both sealants shall provide perfect adhesion as well as insurance against moisture, vapor penetration, resistance to the effects of solvents and oils, and infiltration of any substance.
- .8 Desiccant: The air space between the two glass panes shall be dehydrated with desiccant contained in precise proportions in the spacers. The drying agent shall provide a minimum dewpoint of -58.3 C deg. and a moisture-free air space.
- .9 Glazing Gaskets: ASTM C864, neoprene or EPDM, or ASTM C1115, silicone or thermoplastic polyolefin rubber, molded or extruded shape to fit glazing-channel, and perimeter-frame, retaining slot
- .10 Perimeter Frame: 63.5mm x 112.5mm extruded, insulated, aluminum frame, specifically designed to accept the glass specified.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 General: Install acoustical observation windows in accordance with the requirements as per specifications and manufacturer's recommendations.
- .2 Fastening Method: Fasten frames into rough openings using 25mm x 25mm steel angles, using security screws at 100mm on centers.
- .3 Apply acoustic sealant to seal the entire perimeter of frame to opening of wall assembly.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

- .1 This section includes aluminum, medium duty commercial sliding service windows, and related accessories, as indicated in drawings and specified herein

1.2 RELATED WORK SPECIFIED ELSEWHERE

- | | | |
|----|-------------------|------------------|
| .1 | Rough Carpentry | Section 06 10 00 |
| .2 | Joint Sealants | Section 07 92 00 |
| .3 | Glass and Glazing | Section 08 80 50 |
| .4 | Gypsum Board | Section 09 29 00 |

1.3 SUBMITTALS

- .1 Product Data: Descriptive data and performance attributes to substantiate that products comply with this specification.
- .2 Shop Drawings: Submit for fabrication and installation of windows. Include details, elevations, and hardware.
- .3 Installation Instructions: Shop Drawings shall clearly indicate complete installation details.
- .4 Maintenance Instructions: Manufacturer's printed instructions for cleaning and maintenance of glazed units, including operators.

1.4 SYSTEM DESCRIPTION

- .1 Security window for sliding service window at reception counter shall consist of horizontal sliding panels made of heavy duty aluminum extrusion frames and security glazing, complete with "slam-latch" hardware, and speak-thru's. The unit consists of three panels, a fixed panel on each end, plus one horizontal sliding centre panel. Each of the two fixed end panels includes a hinged drop-down door panel, for mail pass-through, complete with spring-loaded transom latch.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver windows crated to provide protection during transit and job storage.
- .2 Store units in upright position, on blocks, and in dry and safe location.
- .3 Inspect windows upon delivery for damage. Unless minor defects can be made to meet Departmental Representative's specifications and satisfaction, damaged parts should be removed and replaced.

1.6 PROJECT CONDITIONS

- .1 Field measurements: Check opening by accurate field measurement before fabrication. Show recorded measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of work.

1.7 WARRANTY

- .1 All material and workmanship shall be warranted against defects for a period of one (1) year from the date of substantial completion.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Frames: Aluminum frame modules shall be constructed of 6063-T5 extruded aluminium minimum 3mm thickness. Frames shall be 100mm x 45mm nominal size, and shall be designed as channel or stop glazing for single pane interior glazing. Overall frame sizes are to be in accordance with the contract drawings.
- .2 Slides: Window glides on top-hung nylon slides.
- .3 Finish: All aluminum to be clear anodized.
- .4 Glazing: Prep windows to receive 13mm (1/2") security glass supplied by Section 08 80 50.
- .5 Full Bottom Track: to be hung by two heavy duty roller brackets, each having self-lubricating nylon wheel and ball bearing assembly; running in an extruded track assembly. Provide extruded aluminium door glides and retainer clips along bottom for positive guide no-sway operation of sliding panel.
- .6 Drop Down Door Panel/Pass Through: 13mm plywood core with one layer 0.50 aluminium fascia applied each side. All exposed door edges capped with aluminium trim. All perimeter surfaces to be smooth, free of serrations, burrs, or sharp edges.

2.3 ACCESSORIES

- .1 Poly-pile weather stripping
- .2 Speaker Ports - C.R. Laurence Stainless Steel Speak-thru, model no.SST5, brushed stainless steel finish, complete with cork gaskets; adjustable to suit glass thicknesses from 6mm to 32mm (1/4" - 1-1/4"). **No substitutions.**

- .3 Recessed Pull installed interior office side.
- .4 Cylinder Lock with Lock Adams Rite Hook Bolt, thumb turn installed on interior office side. **No substitutions.**
- .5 Rubber Faced Door Stop to restrict movement at maximum in opening.
- .6 Slam Latch for horizontal sliding glass panel. Model to be approved by Departmental Representative.
- .7 Spring Loaded Transom Latch (Model #865) manufactured by Sobihco for Drop Down Door Panel. **No substitutions.**
- .8 Heavy Duty Hinges: two (2) per drop down door panel.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 General: Install acoustical observation windows in accordance with the requirements of specification and as well as manufacturer's recommendations.
- .2 Fastening Method: Fasten frames into rough openings using 25mm x 25mm steel angles, using security screws at 100mm on centers.
- .3 Apply acoustic sealant to seal the entire perimeter of frame to opening of wall assembly.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Metal framed skylight system.
- .2 Integral insulated curb.
- .3 Counter flashings.

1.2 RELATED SECTIONS

- .1 Section 06 10 13 - Wood Blocking and Curbing: Wood support curbs.
- .2 Section 07 61 00: Metal Roofing system and base flashing at skylight curb.
- .3 Section 07 62 00 - Sheet Metal Flashing and Trim: Skylight counter flashing.
- .4 Section 07 92 00 - Joint Sealants.
- .5 Section 08 80 50 - Glass and Glazing.

1.3 REFERENCES

- .1 AAMA 611-12 - Voluntary Specification for Anodized Architectural Aluminum.
- .2 ASTM B221-13 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- .3 ASTM E283-04(2012) - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
- .4 ASTM E330/E330M-14 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- .5 ASTM E331-00(2009) - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
- .6 CSA-A440.2-14/A440.3-14 - Fenestration Energy Performance/User Guide to CSA-A440.2-14, Fenestration Energy Performance.
- .7 CAN/CSA-A440.4-07 (R2012) - Window, Door, and Skylight Installation.
- .8 CSA-A440S1-09 - Canadian Supplement to AAMA/WDMA/CSA 101/I.S.2/A440, NAFS - North American Fenestration Standard/Specification for windows, doors, and skylights.

1.4 SYSTEM DESCRIPTION

- .1 Frame: Aluminum extrusion profile, self supporting; thermally broken with interior tubular section insulated from exterior pressure plate; matching stops and pressure plate of size and strength to provide bite on glazing; drilled drainage holes, deflector plates, and internal flashings to accommodate internal weep; drainage system internal mullion baffles to minimize "stack effect" at internal glazing spaces.

1.5 PERFORMANCE REQUIREMENTS

- .1 Conform to performance requirements of AAMA/WDMA/CSA 101/I.S.2/A440.
- .2 Design and size components to withstand dead and live loads, pressure and suction of wind acting on glazing as calculated in accordance with NBCC code.
- .3 Limit mullion deflection to flexure limit of glass; with full recovery of glazing materials.
- .4 System to accommodate, without damage to system, components or deterioration of seals; movement within system; movement between system and perimeter framing components; dynamic loading and release of loads; deflection of structural support framing.
- .5 Vapour Seal with Interior Atmospheric Pressure of 25 mm sp, 22 degrees C, 40% RH: No failure.
- .6 Water Leakage: None, when measured in accordance with ASTM E331.
- .7 System to provide for expansion and contraction within system components caused by a cycling temperature range of 95 degrees C over a twelve (12) hour period without causing detrimental effect to system components.
- .8 Drain water entering joints, condensation occurring in glazing channels, or route moisture occurring within system, to the exterior by a weep drainage system.
- .9 Maintain continuous air and vapour barrier throughout assembly, primarily in line with inside pane of glass and heel bead of glazing compound. Position thermal insulation on exterior surface of air and vapour barrier.
- .10 Not Permitted: Vibration harmonics, wind whistles, noises caused by thermal movement, thermal movement transmitted to other building elements, loosening, weakening, or fracturing of attachments or components of system.

1.6 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Coordination: Coordinate with other work having a direct bearing on work of this section.
 - .1 Coordinate the work with the installation of wood curbs and roofing system.
 - .2 Coordinate this section with dimensions, tolerances, and method of attachment with other adjacent work.

- .3 Coordinate the work with the continuity of air and air/vapour barrier work of Section 07 27 13.

1.7 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide system and component dimensions, components within assembly, anchorage and fasteners, drainage details and flow diagrams.
- .3 Shop Drawings: Indicate framed opening requirements and tolerances, pane opening sizes, anticipated deflection under load, affected related work, expansion and contraction joint locations and details, and field welding.

1.8 QUALITY ASSURANCE

- .1 Products of This Section: Manufactured to ISO 9000 certification requirements.
- .2 Perform Work in accordance with AAMA/WDMA/CSA 101/I.S.2/A440. Maintain one (1) copy of each document on site.
- .3 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.
- .4 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.
- .5 Design framed skylight system under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed at the place where the Project is located.

1.9 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.
- .2 Provide strippable material to protect prefinished aluminum surfaces. Do not use adhesive papers or spray coatings which bond when exposed to sunlight or weather.

1.10 WARRANTY

- .1 Section 01 78 10: Warranties.
- .2 Provide a five (5) year warranty to include coverage for failure to meet specified requirements, including coverage for insulating glass units from seal failure and installed assembly from moisture penetration.

Part 2 Products

2.1 MANUFACTURERS

- .1 Kawneer; Product: 2000 Skylight.

- .2 Other acceptable manufacturers offering functionally and aesthetically equivalent products.
 - .1 Alumicor; Product: 2300 Skylight.
 - .2 AD Prevost; Product: 3400 Skylight.

2.2 MATERIALS

- .1 Extruded Aluminum: B221M, 6063-T5 alloy and temper.
- .2 Sheet Aluminum: B209M.
- .3 Internal Reinforcement: Steel sections, ASTM A36/A36M.

2.3 ACCESSORIES

- .1 Protective Back Coating: Bituminous paint.
- .2 Fasteners: Galvanized steel.
- .3 Insulation: Glass fibre, stuffing type.
- .4 Flashings: Refer to Section 07 62 00 Sheet Metal Flashings and Trim
- .5 Anchorage Devices: Type recommended by manufacturer, exposed to view.
- .6 Condensation Gutter.

2.4 GLASS AND GLAZING MATERIALS

- .1 Glass: Noted type, as specified in Section 08 80 50.
- .2 Glazing Accessories: As specified in Section 08 80 50.

2.5 SEALANT MATERIALS

- .1 Sealant and Backing Materials: As specified in Section 07 92 00, of types described below.
- .2 Sealant Used Within System (Not Used for Glazing): Silicone type.

2.6 FABRICATION

- .1 Rigidly fit and secure joints and corners with screw and spline. Make joints and connections flush, hairline, and weatherproof.
- .2 Fabricate components allowing for expansion and contraction with minimum clearance and shim spacing around perimeter of assembly, yet enabling installation.
- .3 Maintain continuous air and vapour barrier throughout assembly, with the barrier plane aligned with inside pane of glazing continuing to a heel bead of glazing sealant.
- .4 Drain water entering exterior joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to exterior.
- .5 Prepare components to receive anchor devices. Fabricate anchorage items.
- .6 Arrange fasteners, attachments, and jointing to ensure concealment from view.

2.7 FINISHES

- .1 Clear Anodic Coating: AAMA 611, Class I, AA-M12C22A41.
 - .1 Location: Interior and exterior exposed aluminum surfaces.
- .2 Apply one (1) coat of bituminous paint to concealed metal surfaces in contact with cementitious or dissimilar materials.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that field measurements are as indicated on Shop Drawings.
- .3 Verify that openings and adjoining air and vapour materials are ready to receive work of this Section.

3.2 INSTALLATION

- .1 Install system to manufacturer's written instructions.
- .2 Install system in accordance with CAN/CSA-A440.4.
- .3 Method of attachment to structure to permit sufficient adjustment to accommodate construction tolerances and irregularities.
- .4 Align assembly free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- .5 Attach and seal to adjacent air and vapour retarder materials.
- .6 Install sill flashings.
- .7 Pack fibrous insulation in shim spaces at perimeter of assembly to ensure continuity of thermal barrier.
- .8 Install glass in accordance with Section 08 80 50, using exterior combination method of glazing.
- .9 Install sealant backing materials, Type as noted perimeter sealant, and install in accordance with Section 07 92 00.
- .10 Provide alignment attachments, shims, and anchors required to permanently fasten skylight system to building structure.

3.3 ERECTION TOLERANCES

- .1 Section 01 73 00: Tolerances.
- .2 Alignment of Two Adjoining Members Abutting in Plane: Within 0.4 mm.

3.4 CLEANING

- .1 Section 01 74 00: Cleaning installed work.
- .2 Remove protective material from prefinished aluminum surfaces.

- .3 Wash down exposed surfaces; wipe surfaces clean.
- .4 Remove excess sealant.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

- .1 Furnish all finish hardware including all door operating hardware, such as: hinges, handles, bolts, closers, templates and similar items, thresholds and weatherstripping, as required to make doors functional.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- .1 Finish Carpentry, including installation of finish hardware. Section 06 20 00
- .2 Standard Metal Doors and Frames. Section 08 11 13
- .3 Flush Wood Doors. Section 08 14 16
- .4 Aluminum Storefront. Section 08 40 00
- .5 Power Door Operator. Section 08 42 29

1.3 DESIGN PRINCIPLES AND STANDARDS SAMPLE PANELS AREAS

- .1 Hardware for fire doors shall meet Underwriters requirements. Submit written certification of conformance to ULC requirements for each type of hardware prior to delivery.
- .2 All doors shall be accessible to occupants in wheelchairs, including public and common areas.
- .3 All doors to be handicap accessible and shall have lever handles consistent with the specified grade of locks for that application.

1.4 QUALITY AND MATERIAL STANDARDS

- .1 Make a detailed review of the Schedule of Finish Hardware and make whatever allowance in tender price appropriate to accommodate changes which may be necessary.

- .2 Supplier must be an established contract builders' hardware firm. Persons responsible for the complete finish hardware contract for this project, including: scheduling, detailing, ordering and coordinating hardware, shall be experienced Architectural Hardware Consultants (AHC) and members in good standing with the Door and Hardware Institute (DHI). This representative shall provide the Department Representative with a written report confirming that all hardware items, including electronics, are installed in accordance with the manufacturers' installation instructions and are adjusted and operating properly.
- .3 All finish hardware to conform to CAN/CGSB 69-GP Series-M90/ANSI/BHMA-A156 Series.

1.5 GUARANTEES

- .1 All finish hardware shall be guaranteed by the hardware manufacturer, with written certification, for a period of one (1) year from the date of "substantial completion" against any defects in the design, materials and workmanship, except closers and exit devices. Closers shall have a five (5) year guarantee and exit devices shall have a three (3) year guarantee. Any defects will be made good by the manufacturer at no additional cost to the Department Representative.

1.6 SUBMITTALS

- .1 Submit six (6) copies of the Hardware Schedule to the Department Representative for review.
- .2 Submit following maintenance materials and lists for the Department Representative's use:
 - .1 Three (3) copies of maintenance instructions for hardware.
 - .2 Submit three (3) sets of wrenches for door closers and locksets.
 - .3 Six (6) copies of wiring schematics and riser diagrams.
 - .4 Manufacturer's parts lists and instructions for closers, locksets, exit devices and electronics upon completion of work.

1.7 HANDLING, DELIVERY AND STORAGE

- .1 Package finishing hardware separately for each opening. Identification shall correspond with hardware list symbols. Label all packages legibly, indicating manufacturer's number, type, size and hardware list reference number. Wrap hardware and include screws, bolts and fastenings necessary for proper installation in the package.
- .2 Deliver all items of hardware to the job site in manufacturer's original packages. Clearly mark each item with the proper opening number.
- .3 Provide a signed receipt for hardware delivered.

1.8 PRE-APPROVED ALTERNATES

- .1 Bid only those products specified; or for the purpose of tendering, products listed as equivalents or other pre-approved alternative.
- .2 .Substituted non-approved items will be replaced with specified items and all related costs will be borne by the contractor and supplier. This project will be inspected upon completion to ensure compliance.
- .3 .Submit requests for approval of alternative material or product in writing to the Department Representative no later than ten (10) days prior to bid closing. Submissions shall be made in duplicate. Provide samples of the products and finishes proposed if and when requested by the Department Representative.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Hardware shall be best grade, entirely free from imperfections in manufacture and finish and shall be supplied in accordance with the hardware list specified herein.
- .2 The following list of manufacturers and products are considered approved for this project and no variations from the listed or pre-approved items will be permitted.

- .3 Installed items to be equal in all respects to approved samples.
- .4 Supply all templates as required. Frame manufacturer will allow for maximum swing of doors when templating for closers. On pairs of doors RHR leaf is to be active unless otherwise noted.
- .5 Package hardware with all necessary screws and fittings, clearly labeled with door number as per Door Schedule, as to intended location. Include all necessary installation instructions.
- .6 Any doors not listed shall have hardware as listed for similar locations.

2.2 HARDWARE COMPONENTS

- .1 Hinges:
 - .1 Full Mortise Hinges: 3 knuckle with 2 concealed bearings, non-removable pins. Heavy weight hinges appropriate for heavy weight doors or high frequency use. 0.18 Gauge, 8 holes, material and finish as specified.
 - .2 Electrified Hinges: for heavy weight full mortise bearing hinges as well, allowing a constant flow of current from the power source through the hinge to electrified door hardware. Tamper-proof, non-visible external wires 4 amp continuous @ 12 volts AC or DC per circuit, 28 gauge multi-strand wires. Includes pigtail for connection to the source wiring. Hand of hinge, as specified. Wires coordinated to work with required electro-mechanical hardware. To be installed in the center position on the door. material and finish, as specified, and to match look of non-electrified full mortise hinges.
 - .3 Continuous Hinges: standard duty continuous geared hinge:
 - .1 Material: Extruded tempered aluminum, 6063-T6 alloy.

- .2 Configuration: Three interlocking extrusions in pinless assembly, installed to full height of door frame.
 - .3 Finish (ANSI/BHMA A156.18): Clear anodized.
 - .4 Type: Full mortise.
 - .5 Strength: Standard Duty, 14 bearings each leaf for 2108 mm.
 - .6 Mortise Fasteners: No. 10-16 x 3/4" Fasteners, quad flat stainless steel TEKS.
 - .7 Testing Standard: Tested according to ANSI/BHMA A156.26.
 - .8 Warranty: ten (10) years against defects in material or workmanship.
- .4 Electrified Continuous Hinge Section: continuous geared aluminum hinge section with concealed access to cables and connecting wiring, and as required to operate in conjunction with continuous hinge and electrified lockset:
- .1 Material: Extruded tempered aluminum, 6063-T6 alloy.
 - .2 Configuration: Three interlocking extrusions in pinless assembly, installed to full height of door frame.
 - .3 Finish (ANSI/BHMA A156.18): Clear anodized.

- .4 Type: Full mortise.
 - .5 Electrical Attributes: as required to work with electro-mechanical hardware.
 - .6 Strength: Standard Duty: 14 bearings each leaf for 2108 mm.
 - .7 Mortise Fasteners: No. 10-16 x 3/4" Fasteners, quad flat stainless steel TEKS
 - .8 Testing Standard: Tested according to ANSI/BHMA A156.26.
 - .9 Warranty: ten (10) years against defects in material or workmanship.
- .2 Locksets, Latchsets and Privacy sets: only the following manufacturers and product series will be considered (no substitutions):
- .1 Schlage L Series
 - .2 Sargent 8200 Series
 - .3 Corbin Russwin ML 2200 Series
- Note: Screwless escutcheon plates to be used on exterior doors and high security areas.
- .3 Electromechanical Mortise Locksets: only the following product will be considered (no substitution):
- .1 modified Sargent RX-DX-8200 with deadbolt and thumb latch 12 volt
 - .1 solenoid operated mortise lock;
 - .2 power off lock outside lever;
 - .3 lever insude always retracts latch and deadbolt (simultaneous retract);

- .4 auxillary deadlatch;
- .5 lever outside retracts latch bolt except when the lever outside is Locked;
- .6 access granted by use of credentials, unless deadbolt is thrown;
- .7 when deadbolt is thrown and DX is engaged you cannot prox in.

.4 Keyways: only the following manufacturers and product series will be considered (no substitutions):

- .1 Schlage "D" keyway
- .2 Abloy
- .3 Sargent "NG"

Notes: Schlage "Everest" keyway is not approved.

Locks or cylinders having core removable functions must not be used.

Cylinders must be 6-pin design and pinned to 444444.

.5 Flush bolts & Coordinators: manual flush bolts, with both top and bottom bolts, for double doors. When the active door is opened, the lever can be moved to the 'up' position, retracting the bolt and allowing the inactive leaf to be opened. When the inactive leaf is closed, the lever can be moved to the 'down' position, projecting the bolt into the strike and securely locking the inactive leaf. The following features are also required:

- .1 designed for installation in metal frames.
- .2 flat sided bolt tip to prevent bolt rotation.
- .3 Non-handed
- .4 1/2" Diameter bolt-tip
- .5 3/4" bolt throw with a 7/8" vertical adjustment

- .6 $\frac{3}{4}$ " Bolt backset

- .7 12" standard rod length, measured from the center of the flush bolt body to the bolt tip.

- .8 flush bolt system must have the following options available:
 - .1 automatic
 - .2 constant latching
 - .3 coordinatorDepartmental Representative to confirm if any of the above options are required.

- .6 Closers: Aluminum door closers shall be heavy duty and non-handed to meet a variety of door conditions and design requirements. Door closer series shall have both interior and exterior options, as well as standard arm, offset bracket arm, heavy duty parallel arm and integral door stop options.
 - .1 All closers for both interior and exterior doors shall be the product of one manufacturer and be matched in style.

 - .2 All closers must be ULC listed and certified under ANSI standards A156.4 Grade 1. Use one manufacturer for all closer units throughout the work.

 - .3 Surface closers shall be adjustable to provide sizes 1 through 6 and comply with ADA.

 - .4 Full rack and pinion construction.

 - .5 Closing speed, latching speed and backcheck shall be controlled by key operated valves.

 - .6 Captivated valves.

- .7 Delayed action feature shall be available and controlled by a separate valve. Delayed action shall be available in addition to, not in lieu of, backcheck.
- .8 The one piece closer body shall be of diecast aluminum alloy with 14% silicon minimum content.
- .9 An increase of 15% in closing power shall be provided by means of adjustment of the arm leverage at the foot connection. (Standard arm).
- .10 All arms shall be finely finished with heavy duty forged steel main arm.
- .11 Two mounting positions of the closer shall meet all requirements. Standard mountings shall provide 120 degree door opening and alternate mounting 180 degree door opening.
- .12 All closers shall be suitable for standard, top jamb, parallel arm and track type applications when provided with proper brackets and arms.
- .13 Closer covers shall be of high impact plastic material of flame retardant grade secured by machine screws.
- .14 Projection of closer body from door shall not exceed 56mm.
- .15 The spindle shaft shall be sealed hydraulically with an 'O' ring.
- .16 Metal covers, with rust inhibitor process for closers used in exterior or damp locations such as washrooms or shower rooms.
- .17 All closer bodies have a 10 year limited warranty.
- .18 Closers should comply with UL 10C and UBC 7-2 (1997) Positive Pressure Fire Test.

.7 Door Stops & Pulls:

.1 wall stop: Heavy duty wall mounted door stop for high traffic commercial application. Lockset hits rubber bumper when door is in open position. 2 1/2" diameter overall, maximum 1" projection from wall, brushed chrome finish, with grey convex rubber bumper at centre, concealed fasteners.

.2 pull/push handles: Cylindrical push pull handles for aluminum glazes doors. 25mm (1") diameter aluminum cylinder handles, one each side of door directly opposing one another; 304.8mm (12") centres, 50mm (2") offset from centre of handle to face of door, and 76mm (3") horizontal offset; brushed stainless steel, brushed chrome, or brushed aluminum finish, or as specified (see hardware schedule).

.8 Kick Plates: stainless steel kickplate; 10" tall or as specified; width as required for specified door size (see door schedule); metal kickplate, 20ga Type 304; gauge: minimum 0.050 (1.27); screw type mounting supplied with oval undercut head sheet metal screws standard, all holes countersunk; brushed stainless steel finish.

.9 Thresholds, Seals and Door Bottoms:

.1 interior threshold: extruded aluminum saddle threshold; designed for commercial applications; 127mm (5") width, 12.7mm (1/2") max. height; designed for barrier-free entry and to meet the requirements of ADAAG-1998 (Amended), ICC/ANSI A117.1-2003; tested and approved under UL10C ; category J gaskets for use with listed steel frames and/or classified steel covered composite, hollow metal doors rated up to and including 3 hours; wood and plastic covered composite doors rated up to and including 1-1/2 hours; and wood core doors rated for 20 minutes; manufactured of extruded tempered aluminum 6063-T6.aluminum finish.

- .2 exterior, thermally broken threshold: extruded aluminum thermal barrier saddle threshold; designed for commercial applications; 257mm (10width or as shown on drawings, 12.7mm (1/2") max. height; designed for barrier-free entry and to meet the requirements of ADAAG-1998 (Amended), ICC/ANSI A117.; manufactured of extruded tempered aluminum 6063-T6 with Black rigid vinyl key thermal break; predrilled, with #10-24 Phillips, flat head machine screws of appropriate length; aluminum finish.
- .3 door bottom: door sweep, surface applied to face of door, screw mounted channel 1/4" thick with 1" to 1 1/2" vertical exposure to include beveled top, Black neoprene insert with +/-1" exposure as required; air infiltration tested in accordance with the requirements of ASTM E-283 *Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors*; Smoke Tested in accordance with UL 1784-2001 *Air Leakage Tests of Door Assemblies*, and meets the performance criteria for allowable air leakage as specified in NFPA 105-99 *Installation of Smoke Control Door Assemblies*; Fire Rated - UL10C - Positive Pressure, gasket material classified for use on listed steel frames and classified hollow metal steel composite type fire doors rated up to and including 3 hours, tested to meet the requirements of UL 10B and UL 10C, Fire Tests of Door Assemblies, UBC 7-2 Fire Tests of Door Assemblies Part 1-1997, and NFPA 252 with the neutral pressure plane regulated at 40", products meet the requirements for Category J – Gaskets; Clear anodized aluminum finish with black neoprene gasket.
- .4 seals: perimeter rigid jamb gasketing designed to seal the gap around the top and the 2 sides of a door assembly. side jambs are provided as two pieces. air infiltration tested in accordance with the requirements of ASTM E-283 *Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors*; Smoke Tested in accordance with UL 1784-2001 *Air Leakage Tests of Door Assemblies*, and meets the performance criteria for allowable air leakage as specified in NFPA 105-99 *Installation of*

Smoke Control Door Assemblies; Fire Rated - UL10C - Positive Pressure, gasket material classified for use on listed steel frames and classified hollow metal steel composite type fire doors rated up to and including 3 hours, tested to meet the requirements of UL 10B and UL 10C, Fire Tests of Door Assemblies, UBC 7-2 Fire Tests of Door Assemblies Part 1-1997, and NFPA 252 with the neutral pressure plane regulated at 40", products meet the requirements for Category J – Gaskets; Clear anodized aluminum finish with black neoprene gasket. Clear; Anodized aluminum finish, or as specified by Department Representative (see specification); Black EPDM gasket insert.

Note: ULC fire/sound/smoke labels where required.

Thresholds for all doors shall allow for passage of a wheelchair.

Thermally broken thresholds at exterior doors.

Threshold widths as shown on drawings.

All thresholds, door bottoms, and seals to have minimum three (3) year guarantee against defects in materials or workmanship.

.10 Overhead Stops: Concealed-mount overhead stop for Interior or exterior high traffic doors, with the following features:

- .1 Non-handed
- .2 Slide track design
- .3 Stop function
- .4 Heavy shock absorber spring provides 5°-7° compression before dead stop
- .5 appropriate for wood or metal door and frames of 1 3/4" door thickness or as specified.
- .6 110° maximum opening
- .7 1-3/16" tube track
- .8 Satin Stainless Steel finish.

.11 Auto Door Operators:

See Section 08 42 29.

.12 Door Viewers: Only the following products will be considered (no substitutions):

- .1 Loxem 190 (from Taymour Industries)
- .2 Madison No 20 R35 (from Madison Products Company Ltd.)
- .3 Ives No. 698B3 (from Leigh Metal Products Ltd.)
- .4 Ives No. U698B3 for fire rated doors (from Leigh Metal Products Ltd.)
- .5 ASD Metallic Industries DS238 (from Advanced Safety Devices)

.13 Sliding Cell Door Locks: Only the following products will be considered (no substitutions):

- .1 Chubb 1030D-1
- .2 Folger Adam 32D
- .3 Southern Steel 1030-D1
- .4 RR Brink 7030D.

.14 Exiting Device or Electric Strike: T.B.C. by Departmental Representative.

2.3 ACCESSORIES

- .1 High Security Key Cabinet: Recessed cabinet complete with flush-mounted combination lock and hinges. Cabinet to be 12 gauge steel epoxy coated with min. 12-key capacity, to be confirmed by Departmental Representative. Key cabinet to be installed in room 107 in location to be confirmed by Departmental Representative.

2.4 KEYING

- .1 Project requires construction keying only. Building to be re-keyed by other once it is occupied by Department Representative.
- .2 Provide 6 each master keys.

2.5 FINISH

- .1 All hardware finishes shall match throughout the project, generally satin chrome, stainless steel or as noted in the finish hardware schedule.

PART 3 EXECUTION

3.1 COOPERATION

- .1 Confer with the various sections of work and refer to the detail drawings before ordering hardware to be sure that it will conform to and fit actual conditions on the job.
- .2 Before furnishing hardware, check drawings for hardware requirements, verify door swings, check shop drawings, frame and door lists, and advise in writing if revisions are required. Ensure early delivery of hardware required for this project.
- .3 Supply complete information and templates required by the metal door and frame manufacturers to provide reinforcing for the application of hardware.
- .4 Submit the names of hardware manufacturers used in the preparation of the Tender. If the manufacturer's names are not stated, it shall be understood to mean that the hardware will be purchased from the manufacturers specified.
- .5 Submit cuts, illustrations or samples of the following items proposed for this project immediately following award of Contract and before ordering hardware:
 - .1 Hinges
 - .2 Locksets
 - .3 Latchsets & Strikes

- .4 Exit Devices
- .5 Closers
- .6 Specialty Items

3.2 DOOR VIEWERS – Install at 1570mm above floor. Generally install to view from inside looking out, unless specifically noted otherwise. Contact Department Representative for clarifications as required.

3.3 HARDWARE SCHEDULE – see following nine (9) pages.

END OF SECTION

Primary Wing

ITEM 1		<u>SINGLE DOOR TYPE-A EXTERIOR TO PUBLIC ENTRY VESTIBULE 100</u>		LHR
100A	1	900 x 2150 x 45 ALD x ALF SEALED DOUBLE GLAZED		
	1	EA. ELEC. CONTINUOUS HINGE	FM 83 SLF HD1 QC8-SER T.B.C.	C
	1	EA. DORMITORY OR EXIT LOCKSET W/ LATCH HOLDBACK	(ANSI F13) T.B.C. T.B.C.	26D 26D
	1	EA. OR W/ ELECTRIC STRIKE	T.B.C.	
	2	EA. LOCK CYLINDER	41 STD CAM NG KWY 4 BITTED T.B.C.	26D
	1	EA. HARNESS - LOCK TO HINGE	QC-C300 T.B.C.	
	1	EA. HARNESS - HINGE TO JCTN BOX	QCC-1500-P T.B.C.	
	1	EA. AUTO DOOR OPENER	SECTION 084229	
	1	EA. THRESHOLD	255x5_FG	A
	1	EA. WEATHERSTRIP	319_N	C
	1	EA. SWEEP	315_N	C
		NOTE: DOOR CLOSER TO BE INCLUDED IN DOOR OPENER DOOR STOP INTEGRAL TO AUTO OPENER SEE OPERATIONAL DESCRIPTION (APPENDIX A) HARDWARE SPECIFICATION FOR THIS DOOR T. B. C. W/ DEPARTMENTAL REPRESENTATIVE		
ITEM 2		<u>SINGLE DOOR TYPE-Aa VESTIBULE 100 TO LOBBY 101</u>		RHR
100B	1	900 x 2150 x 45 ALD-GLAZED x ALF		
	1	EA. CONTINUOUS HINGE	FM 83 SLF HD1	C
	1	EA. PUSH/PULL	1180-2 x 1180-2 x #5 MTG.	32D
	1	EA. AUTO DOOR OPENER	SECTION 084229	
		NOTE: DOOR CLOSER TO BE INCLUDED IN DOOR OPENER DOOR STOP INTEGRAL TO AUTO OPENER		
ITEM 3		<u>SINGLE DOOR TYPE-E LOBBY 101 TO PRIMARY CORRIDOR 112</u>		LHR
101	1	900 x 2150 x 45 SCWD x PSF STC 50		
	3	EA. BUTT HINGES	TA 786 4 1/2 x 4 (NRP)	26D
	1	EA. HOTEL LOCKSET	LC-8250 LNL (ANSI F15)	26D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4 BITTED	26D
	1	EA. DOOR CLOSER W/ STOP	351-PS	EN
	1	EA. KICKPLATE	80A (10")	32D
		NOTE: ACOUSTIC DOOR SEAL AND THRESHOLD COMPLETED BY SUPPLIER SEE OPERATIONAL DESCRIPTION (APPENDIX A) - T.B.C. W/ DEPARTMENTAL REPRESENTATIVE		
ITEM 4		<u>SINGLE DOOR TYPE-E LOBBY 101 TO MULTI-PURPOSE 102</u>		LH
102A	1	900 x 2150 x 45 SCWD x PSF STC 50		
	3	EA. BUTT HINGES	TA 786 4 1/2 x 4 (NRP)	26D
	1	EA. HOTEL LOCKSET	LC-8250-LNL (ANSI F15)	26D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4 BITTED	26D
	1	EA. DOOR CLOSER	351-0	EN
	1	EA. KICKPLATE	80A (10")	32D
	1	EA. WALL STOP	240B	26D
		NOTE: DOOR SEAL COMPLETED BY SUPPLIER		
ITEM 5		<u>SINGLE DOOR TYPE-E MULTI-PURPOSE 102 TO PRIMARY CORRIDOR 112</u>		RHR
102B	1	900 x 2150 x 45 SCWD x PSF STC 50		
	3	EA. BUTT HINGES	TA 786 4 1/2 x 4 (NRP)	26D
	1	EA. DORMITORY OR EXIT	LC-8246-LNL (ANSI F13)	26D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4 BITTED	26D
	1	EA. DOOR CLOSER W/ STOP	351-PS	EN
	1	EA. KICKPLATE	80A (10")	32D
		NOTE: DOOR SEAL AND THRESHOLD COMPLETED BY SUPPLIER		
ITEM 6		<u>SINGLE DOOR TYPE-D LOBBY 101 TO PUBLIC WASHROOM 103</u>		LHR
103	1	900 x 2150 x 45 SCMD x PSF UNDERCUT 19MM		

3	EA.	BUTT HINGES	TA 786 4 1/2 x 4 (NRP)	26D
1	EA.	HOTEL LOCKSET	LC-8204-LNL (ANSI F07)	26D
1	EA.	LOCK CYLINDER	41 STD CAM NG KWY 4 BITTED	26D
1	EA.	DOOR CLOSER W/ STOP	351-PS	EN
1	EA.	KICKPLATE	80A (10")	32D

ITEM 7 **SINGLE DOOR TYPE-E LOBBY 101 TO SOFT INTERVIEW 104** LH
104A 1 900 x 2150 x 45 SCWD x PSF STC 50

3	EA.	BUTT HINGES	TA 786 4 1/2 x 4 (NRP)	26D
1	EA.	HOTEL LOCKSET	LC-8204-LNL (ANSI F07)	26D
1	EA.	LOCK CYLINDER	41 STD CAM NG KWY 4 BITTED	26D
1	EA.	DOOR CLOSER W/ STOP	351-PS	EN
1	EA.	KICKPLATE	80A (10")	32D

NOTE: DOOR SEAL AND THRESHOLD COMPLETE BY DOOR SUPPLIER

ITEM 8 **SINGLE DOOR TYPE-E PRIMARY CORRIDOR 112 TO SOFT INTERVIEW 104** LH
104B 1 900 x 2150 x 45 SCWD x PSF STC 50

3	EA.	BUTT HINGES	TA 786 4 1/2 x 4 (NRP)	26D
1	EA.	HOTEL LOCKSET	LC-8250-LNL (ANSI F15)	26D
1	EA.	LOCK CYLINDER	41 STD CAM NG KWY 4 BITTED	26D
1	EA.	DOOR CLOSER W/ STOP	351-PS	EN
1	EA.	KICKPLATE	80A (10")	32D

NOTE: DOOR SEAL AND THRESHOLD COMPLETE BY DOOR SUPPLIER

ITEM 9 **SINGLE DOOR TYPE-D PRIMARY CORRIDOR 112 TO GENERAL STORAGE 105** LH
105 1 900 x 2150 x 45 SCWD x PSF

3	EA.	BUTT HINGES	TA 786 4 1/2 x 4 (NRP)	26D
1	EA.	HOTEL LOCKSET	LC-8204-LNL (ANSI F07)	26D
1	EA.	LOCK CYLINDER	41 STD CAM NG KWY 4 BITTED	26D
1	EA.	DOOR CLOSER W/ STOP	351-PS	EN
1	EA.	KICKPLATE	80A (10")	32D

ITEM 10 **SINGLE DOOR TYPE-Aa PRIMARY CORRIDOR 112 TO EXERCISE 106** RH
106 1 900 x 2150 x 45 ALD-GLAZED x ALF

3	EA.	BUTT HINGES	TA 786 4 1/2 x 4	26D
1	EA.	PASSAGE SET	8215-LNL (ANSI F01)	26D
1	EA.	DOOR CLOSER W/ STOP	321-PS	EN

ITEM 11 **SINGLE DOOR TYPE-G PRIMARY CORRIDOR 112 TO EQUIPMENT 107** RH
107 1 900 x 2150 x 45 HMD x PSF

3	EA.	BUTT HINGES	TA 786 4 1/2 x 4 (NRP)	26D
1	EA.	HOTEL LOCKSET	LC-8250-LNL (ANSI F15)	26D
1	EA.	LOCK CYLINDER	41 STD CAM NG KWY 4 BITTED	26D
1	EA.	DOOR CLOSER W/ STOP	321-PS	EN
1	EA.	KICKPLATE	80A (10")	32D

ITEM 12 **SINGLE DOOR TYPE-G PRIMARY CORRIDOR 112 TO STAFF WASHROOM 108** RH
108 1 900 x 2150 x 45 HMD x PSF UNDERCUT 19MM

3	EA.	BUTT HINGES	TA 714 4 1/2 x 4	26D
1	EA.	PRIVACY BATH /BEDROOM SET	LC-8265-LNL (ANSI F22)	26D
1	EA.	KICKPLATE	80A (10")	32D
1	EA.	O.H. STOP	1-336	26D

ITEM 13 **SINGLE DOOR TYPE-C STAFF VESTIBULE 111 TO MECH. 109** LH

109	1	900 x 2150 x 45 HMD x PSF 45 MIN. ULC RATED		
	3	EA. BUTT HINGES	TA 786 4½ x 4 (NRP)	26D
	1	EA. STOREROOM LOCKSET	LC-8204-LNL (ANSI F07)	26D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4 BITTED	26D
	1	EA. DOOR CLOSER	351-0	EN
	1	EA. KICKPLATE	80A (10")	32D
	1	EA. WALL STOP	240B	26D
ITEM 14 110		<u>SINGLE DOOR TYPE-C STAFF VESTIBULE 111 TO ELEC. 110</u>		LH
	1	900 x 2150 x 45 HMD x PSF 45 MIN. ULC RATED		
	3	EA. BUTT HINGES	TA 786 4½ x 4 (NRP)	26D
	1	EA. STOREROOM LOCKSET	LC-8204-LNL (ANSI F07)	26D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4 BITTED	26D
	1	EA. DOOR CLOSER	351-0	EN
	1	EA. KICKPLATE	80A (10")	32D
	1	EA. WALL STOP	240B	26D
ITEM 15 111A		<u>SINGLE DOOR TYPE-B EXTERIOR TO STAFF VESTIBULE 111</u>		RHR
	1	900 x 2150 x 45 INS-HMD x PSF THERMALLY BROKEN		
	2	EA. BUTT HINGES	TA 386 4½ x 4 (NRP)	32D
	1	EA. POWER TRANSFER HINGE	TA 786 QC8	26D
	1	EA. ELECTRICAL (FAIL SECURE) LOCKSET W/ MOD. HOTEL FCTN.	LC-RXD8271 /W DEADBOLT + THUMB TURN 12V LNL (MODIFIED ANSI F15)	26D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4 BITTED	26D
	1	EA. HARNESS - LOCK TO HINGE	QC-C300	
	1	EA. HARNESS - HINGE TO JCTN BOX	QCC-1500-P	
	1	EA. POWER SUPPLY	BPS 12-1	
	1	EA. DOOR CLOSER W/ STOP	351-PS	
	1	EA. KICKPLATE	80A (10")	32D
	1	EA. VIEWER	595 - VIEW TO EXTERIOR	26D
	1	EA. THRESHOLD	255x5_FG	A
	1	EA. WEATHERSTRIP	319_N	MATCH FRAME
	1	EA. SWEEP	315_N	MATCH FRAME
		NOTE: CARD READER /END DEVICE ONLY BY OTHERS MODIFIED RxDx LOCKSET C/W ELECTRIFIED UNLOCKING FUNCTION SEE OPERATIONAL DESCRIPTION (APPENDIX A)		
ITEM 16 111B		<u>SINGLE DOOR TYPE-Aa STAFF VESTIBULE 111 TO PRIMARY CORRIDOR 112</u>		RHR
	1	900 x 2150 x 45 ALD-GLAZED x ALF		
	1	EA. CONTINUOUS HINGE	FM 83 SLF HD1	C
	1	EA. PUSH/PULL	1180-2 x 1180-2 x #5 MTG. F01	32D
	1	EA. O.H. STOP	1-336	EN
		NOTE: DOOR CLOSER TO BE INCLUDED IN DOOR OPENER		
ITEM 17 112A		<u>SINGLE DOOR TYPE-B EXTERIOR TO PRIMARY CORRIDOR 112</u>		LHR
	1	900 x 2150 x 45 INS-HMD x PSF THERMALLY BROKEN		
	3	EA. BUTT HINGES	TA 386 4½ x 4 (NRP)	C
	1	EA. HOTEL LOCKSET	LC-8250-LNL (ANSI F15)	32D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4 BITTED	26D
	1	EA. KICKPLATE	80A (10")	32D
	1	EA. DOOR CLOSER	351-PS	26D
	1	EA. VIEWER	595 - VIEW TO EXTERIOR	32D
	1	EA. THRESHOLD	255x5_FG	A
	1	EA. WEATHERSTRIP	319_N	MATCH FRAME
	1	EA. SWEEP	315_N	MATCH FRAME
	1	EA. O.H. STOP	1-336	26D
ITEM 18		<u>SINGLE DOOR TYPE-Ca PRIMARY CORRIDOR 112 TO CORRIDOR 203</u>		RHR

112B	1	900 x 2150 x 45 HMD x PSF 1.5HR. ULC RATED	
	2	EA. BUTT HINGES	TA 786 4½ x 4 (NRP) 26D
	1	EA. STORE DOOR LOCKSET	LC-7826-KE2-B (ANSI F14 W/ KNOBS) 26D
	2	EA. LOCK CYLINDER	41 STD CAM NG KWY 4 BITTED 26D
	1	EA. DOOR CLOSER W/ STOP	351-PS 26D
	1	EA. KICKPLATE	80A (10") 32D
	2	EA. DOOR VIEWER	595 (ONE IN EACH DIRECTION) 26D
ITEM 19		<u>SINGLE DOOR TYPE-Da OPEN WORK AREA 113 TO ELEC. CLOSET</u>	RHR
113	1	750 x 2150 x 45 SCWD x PSF	
	3	EA. BUTT HINGES	TA 714 4½ x 4 26D
	1	EA. STORE ROOM OR CLOSET	LC-8204-LNL (ANSI F07) 26D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4 BITTED 26D
	1	EA. O.H. STOP	1-336 26D
ITEM 20		<u>SINGLE DOOR TYPE-F OPEN WORK ARE 113 TO PRIVATE OFFICE 114</u>	RH
114	1	900 x 2150 x 45 SCWD x PSF	
	3	EA. BUTT HINGES	TA 714 4½ x 4 26D
	1	EA. OFFICE LOCKSET	LC-8205-LNL (ANSI F04) 26D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4 BITTED 26D
	1	EA. KICKPLATE	80A (8") 32D
	1	EA. O.H. STOP	1-336 26D
	1	EA. DOOR SEAL	S773D
	1	EA. DOOR BOTTOM	420 APKL
	1	EA. ACOUSTIC CORNER PAD	ACP112 BL
	1	EA. THRESHOLD	171A
ITEM 21		<u>SINGLE DOOR TYPE-C OPEN WORK AREA TO RECORDS 115</u>	LH
115	1	900 x 2150 x 45 HMD x PSF 45MIN. ULC RATED	
	3	EA. BUTT HINGES	TA 786 4½ x 4 (NRP) 26D
	1	EA. HOTEL LOCKSET	LC-8250-LNL (ANSI F15) 26D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4 BITTED 26D
	1	EA. DOOR CLOSER W/ STOP	351-PS EN
	1	EA. KICKPLATE	80A (10") 32D
ITEM 22		<u>SINGLE DOOR TYPE-D PRIM. CORRIDOR 112 TO LOCKER ROOM 116</u>	LH
116	1	915 x 2135 x 45 SCWD x PSF DOOR GRILL (SEE MECH)	
	3	EA. BUTT HINGES	TA 786 4½ x 4 26D
	1	EA. PASSAGE SET	8215-LNL (ANSI F01) 32D
	1	EA. DOOR CLOSERS W/ STOP	351-PS 26D
	1	EA. KICKPLATES	80A (8") 32D
			26D
ITEM 23		<u>SINGLE DOOR TYPE-D LOCKER ROOM 116 TO SHOWER ROOM 117</u>	LH
117	1	900 x 2150 x 45 SCWD x PSF UNDERCUT 19MM	
	3	EA. BUTT HINGES	TA 714 4½ x 4 26D
	1	EA. PRIVACY BATH /BEDROOM SET	LC-8265-LNL (ANSI F22) 26D
	1	EA. KICKPLATE	80A (10") 32D
	1	EA. O.H. STOP	1-336 26D
ITEM 24		<u>SINGLE DOOR TYPE-C PRIM. CORRIDOR 112 TO TEMP STORAGE 118</u>	RH
118	1	900 x 2150 x 45 HMD x PSF 45MIN. ULC RATED	
	3	EA. BUTT HINGES	TA 786 4½ x 4 (NRP) 26D
	1	EA. STOREROOM OR CLOSET	LC-8204-LNL (ANSI F07) 26D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4-BITTED 26D
	1	EA. DOOR CLOSER W/ STOP	351-PS 26D

	1	EA. KICKPLATE	80A (10")	232D 26D
ITEM 25		<u>SINGLE DOOR TYPE-C TEMP. STORAGE 118 TO STORAGE 119</u>		RH
119	2	900 x 2150 x 45 INSULATED HMD x PSF 45MIN. ULC RATED		
	3	EA. BUTT HINGES	TA 786 4 1/2 x 4 (NRP)	26D
	1	EA. HOTEL LOCKSET	LC-7850-KE2-B (ANSI F15k)	26D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4-BITTED	26D
	1	EA. DOOR CLOSER W/ STOP	351-PS	EN
	1	EA. KICKPLATE	80A (10")	32D
ITEM 26		<u>SINGLE DOOR TYPE-Gb CORRIDOR 112 TO TEL 120</u>		RHR
120	1	1065 x 2150 x 45 HMD x PSF UNDERCUT 19MM		
	3	EA. BUTT HINGES	TA 786 4 1/2 x 4 (NRP)	26D
	1	EA. HOTEL LOCKSET	LC-8250-LNL (ANSI F15)	26D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4-BITTED	26D
	1	EA. DOOR CLOSER W/ STOP	351-PS	32D
	1	EA. KICKPLATE	80A (10")	232D
	1	EA. ASTRAGAL	357 SPND	MATCH DOOR
		NOTE: STEEL ASTRAGAL TO BE WELDED TO DOOR BY DOOR SUPPLIEF		
ITEM 27		<u>SINGLE DOOR TYPE-Gb CORRIDOR 112 TO ROOM 121</u>		LHR
121	1	1065 x 2150 x 45 HMD x PSF		
	3	EA. BUTT HINGES	TA 786 4 1/2 x 4 (NRP)	26D
	1	EA. HOTEL LOCKSET	LC-8250-LNL (ANSI F15)	26D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4-BITTED	26D
	1	EA. DOOR CLOSER W/ STOP	351-0	32D
	1	EA. KICKPLATE	80A (10")	232D
	1	EA. ASTRAGAL	357 SPND	MATCH DOOR
		NOTE: STEEL ASTRAGAL TO BE WELDED TO DOOR BY DOOR SUPPLIEF		
ITEM 28		<u>SINGLE DOOR TYPE-Ea CORRIDOR 112 TO ROOM 122</u>		RH
122	1	900 x 2150 x 45 MD x PSF STC-50		
	3	EA. BUTT HINGES	TA 786 4 1/2 x 4 (NRP)	26D
	1	EA. HOTEL LOCKSET	LC-8250-LNL (ANSI F15)	26D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4-BITTED	26D
	1	EA. DOOR CLOSER	351-0	32D
	1	EA. KICKPLATE	80A (10")	32D
	1	EA. WALL STOP	240B	26D
		NOTE: DOOR SEAL AND THRESHOLD COMPLETE BY DOOR SUPPLIER		
ITEM 29		<u>SINGLE DOOR TYPE-G CORRIDOR 112 TO JAN 123</u>		LH
123	1	900 x 2150 x 45 SCWD x PSF 19MM UNDERCUT		
	3	EA. BUTT HINGES	TA 786 4 1/2 x 4 STANDARD	26D
	1	EA. STOREROOM LOCKSET	LC-8204-LNL (ANSI F07)	26D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4-BITTED	26D
	1	EA. DOOR CLOSER	351-0	EN
	1	EA. KICKPLATE	80A (10")	32D
	1	EA. WALL STOP	240B	26D
ITEM 30		<u>SINGLE DOOR TYPE-B EXTERIOR TO VEHICLE BAY 201</u>		LHR
201	1	900 x 2150 x 45 INS-HMD x PSF THERMALLY BROKEN		
	3	EA. BUTT HINGES	TA 386 4 1/2 x 4 (NRP)	C
	1	EA. STORE DOOR LOCKSET	LC-7826-KE2-B (ANSI F14 W/ KNOBS)	26D
	2	EA. LOCK CYLINDER	41 STD CAM NG KWY 4-BITTED	26D
	1	EA. KICKPLATE	80A (10")	32D
	1	EA. O.H. STOP	1-336	26D

1	EA.	VIEWER	595 - VIEW TO EXTERIOR	26D
1	EA.	THRESHOLD	255x5_FG	A
1	EA.	WEATHERSTRIP	319_N	MATCH FRAME
1	EA.	SWEEP	315_N	C

ITEM 31 **SINGLE DOOR TYPE-B EXTERIOR TO HRV/PUMP 202** RHR
202

1		900 x 2150 x 45 INS-HMD x PSF THERMALLY BROKEN		
3	EA.	BUTT HINGES	TA 386 4½ x 4 (NRP)	C
1	EA.	HOTEL LOCKSET	LC-7850-KE2-B (ANSI F15 W/ KNOBS)	26D
1	EA.	LOCK CYLINDER	41 STD CAM NG KWY 4-BITTED	26D
1	EA.	KICKPLATE	80A (10")	32D
1	EA.	O.H. STOP	1-336	26D
1	EA.	THRESHOLD	255x5_FG	A
1	EA.	WEATHERSTRIP	319_N	MATCH FRAME
1	EA.	SWEEP	315_N	C

ITEM 32 **SINGLE DOOR TYPE-Ca VEHICLE 201 TO CORRIDOR 203** LH
203A

1		900 x 2150 x 45 HMD x PSF 1.5HR. MIN. ULC RATED		
3	EA.	BUTT HINGES	TA 786 4½ x 4 (NRP)	26D
1	EA.	STOREROOM LOCKSET	LC-7826-KE2-B (ANSI F14 W/ KNOBS)	26D
2	EA.	LOCK CYLINDER	41 STD CAM NG KWY 4-BITTED	26D
1	EA.	DOOR CLOSER	351-P10	EN
1	EA.	KICKPLATE	80A (10")	32D
1	EA.	WALL STOP	240	26D
2	EA.	DOOR VIEWER (FIRE RATED)	UG698B3 (ONE EACH DIRECTION)	26D
1	EA.	SEALS (ULC)	319_N	MATCH FRAME
1	EA.	SWEEPS (ULC)	315_N	C
1	EA.	THRESHOLD (ULC / HC)	171	A

ITEM 33 **SINGLE DOOR TYPE-B EXTERIOR TO CORRIDOR 203** RHR
203B

1		900 x 2150 x 45 INS-HMD x PSF THERMALLY BROKEN		
1	EA.	HINGE	TA 386 4-1/2 X 4 (NRP)	C
1	EA.	STORE DOOR LOCKSET	LC-7826-KE2-B (ANSI F14 W/ KNOBS)	26D
2	EA.	LOCK CYLINDER	41 STD CAM NG KWY 4-BITTED	26D
1	EA.	KICKPLATE	80A (10")	32D
1	EA.	O.H. STOP	1-336	26D
1	EA.	VIEWER	595 - VIEW TO EXTERIOR	TBD
1	EA.	THRESHOLD	255x5_FG	A
1	EA.	WEATHERSTRIP	319_N	MATCH FRAME
1	EA.	SWEEP	315_N	C

ITEM 34 **SINGLE DOOR TYPE-Ea CORRIDOR 203 TO ROOM 204** RH
204

1		900 x 2150 x 45 MD x PSF STC-50		
3	EA.	BUTT HINGES	TA 786 4½ x 4 (NRP)	26D
2	EA.	STOREROOM LOCKSET	LC-7826-KE2-B (ANSI F14 W/ KNOBS)	26D
1	EA.	LOCK CYLINDER	41 STD CAM NG KWY 4-BITTED	26D
1	EA.	DOOR CLOSER	351-PS	EN
1	EA.	O.H. STOP	1-336	26D

NOTE: DOOR SEAL AND THRESHOLD COMPLETE BY DOOR SUPPLIER

ITEM 35 **SINGLE DOOR TYPE-G ROOM 205 TO WC 206** RH
206

1		900 x 2150 x 45 HMD x PSF 19MM UNDERCUT		
3	EA.	BUTT HINGES	TA 714 4½ x 4	26D
1	EA.	PASSAGE SET	7815-KE2-B (ANSI F01) W/ KNOB	26D
1	EA.	O.H. STOP	1-336	26D

ITEM 36 **SINGLE DOOR TYPE-Hb CORRIDOR 203 TO SHOWER 207** RHR

207		914 x 2143 x 45 HMD x PSF	VERTICAL VIEWPORT W/ SHUTTER	
	3	EA. BUTT HINGES	TA 386 4½ x 4 (NRP)	32D
	1	EA. DEADLOCKS	LC-7820-KE2-B* (ANSI F18*) W/ KNOB	26D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4-BITTED	26D
	1	EA. DOOR CLOSER	351-0	EN
	1	EA. O.H. STOP	1-336	32D
		NOTE: *F18 WITH DUMMY TRIM KNOB CORRIDOR SIDE, NO TRIM SHOWER SIDE		
ITEM 37		<u>SINGLE DOOR TYPE-G CORRIDOR 203 TO JAN 208</u>		LHR
208	1	900 x 2150 x 45 HMD x PSF	19MM UNDERCUT	
	3	EA. BUTT HINGES	TA 786 4½ x 4 (NRP)	26D
	1	EA. STOREROOM LOCKSET	LC-7804-KE2-B (ANSI F07 W/ KNOB)	26D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4-BITTED	26D
	1	EA. DOOR CLOSER	351-CPS	EN
ITEM 38		<u>SINGLE DOOR TYPE-H CORRIDOR 203 TO ROOM 209</u>		SLIDING
ITEM 39		<u>SINGLE DOOR TYPE-H CORRIDOR 203 TO ROOM 210</u>		SLIDING
209 + 210	2	978 x 2065 (RO 914 x 2125) STEEL	VERTICAL VIEWPORT W/ SHUTTER	
	2	EA. PRISON LOCKS	FOLGER ADAM 32D	
		BALANCE OF HARDWARE BY DOOR SUPPLIER		
ITEM 40		<u>SINGLE DOOR TYPE-Hb CORRIDOR 201 TO ROOM 211</u>		LH
ITEM 41		<u>SINGLE DOOR TYPE-Hb CORRIDOR 201 TO ROOM 212</u>		LH
211 + 212	2	900 x 2150 x 45 HMD PSF	VERTICAL VIEWPORT W/ SHUTTER	
	6	EA. BUTT HINGES	TA 786 4½ x 4 (NRP)	26D
	2	EA. STOREROOM LOCKSET	LC-7804-KE2-B (ANSI F07 W/ KNOB)	26D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4-BITTED	26D
	2	EA. DOOR CLOSER	351-CPS	EN
	2	EA. O.H. STOP	1-336	32D
ITEM 42		<u>SINGLE DOOR TYPE-Ha CORRIDOR 201 TO MECH CHASE 213</u>		RHR
213	2	810 x 2100 x 45 HMD x PSF		
	6	EA. BUTT HINGES	TA 714 4½ x 4 (NRP)	26D
	1	EA. DEADLOCK	LC-8220 (ANSI F18) C/W KEY ONLY	26D
	1	EA. LOCK CYLINDER	41 STD CAM NG KWY 4-BITTED	26D
		NOTE: NO TRIM ON INSIDE		
<u>Cold Storage</u>				
ITEM 43		<u>SINGLE DOOR TYPE-B EXTERIOR TO COLD STORAGE 301</u>		RH
301	1	900 x 1250 x 45 INS-HMD x PSF	THERMALLY BROKEN	
	3	EA. BUTT HINGES	TA 386 4½ x 4 (NRP)	32D
	1	EA. STOREROOM LOCKSET	LC-7826-KE2-B (ANSI F15 W/ KNOB)	26D
	2	EA. LOCK CYLINDER	41 STD CAM NG KWY 4-BITTED	26D
	1	EA. DOOR CLOSER W/ STOP	351-PS	EN
	1	EA. KICKPLATE	80A (10")	32D
	1	EA. DOOR VIEWER	595 - VIEW TO EXTERIOR	26D
	1	EA. WEATHERSTRIP	319_N	MATCH DOOR
	1	EA. DOOR SWEEP	315_N	C
	1	EA. THRESHOLD	255x5_FG	
ITEM 44		<u>PAIR DOORS TYPE-J COLD STORAGE 301 TO STORAGE 302</u>		RHRA/LHR
302	2	900 x 2150 x 45 HMD x PSF		
	6	EA. BUTT HINGES	TA 786 4½ x 4 (NRP)	26D
	1	EA. STOREROOM LOCKSET	LC-7804-KE2-B (ANSI F15 W/ KNOB)	26D

1	EA.	LOCK CYLINDER	41 STD CAM NG KWY 4-BITTED	26D
2	EA.	DOOR CLOSERS	351-0	EN
2	EA.	KICKPLATES	80A (10")	32D
2	EA.	FLUSHBOLTS	401 x 12"	26D
1	EA.	D.P. STRIKE	410	26D
1	EA.	FLUSH BOLT (MANUAL)	IVES FB457	
1	EA.	ASTRAGAL	357 SPND	

NOTE: STEEL ASTRAGAL WELDED TO PRIMARY DOOR BY DOOR SUPPLIER

ITEM 45		<u>SINGLE DOOR TYPE-G COLD STORAGE 301 TO STORAGE 303</u>		RHR
303	1	900 x 2150 x 45 HMD x PSF		
	3	EA.	BUTT HINGES TA 786 4½ x 4 (NRP)	26D
	1	EA.	STOREROOM LOCKSET LC-7804-KE2-B (ANSI F15 W/ KNOB)	26D
	1	EA.	LOCK CYLINDER 41 STD CAM NG KWY 4-BITTED	26D
	2	EA.	DOOR CLOSERS 351-0	EN
	2	EA.	KICKPLATES 80A (10")	32D
	2	EA.	FLUSHBOLTS 401 x 12"	26D
	1	EA.	D.P. STRIKE 410	26D

Overhead Doors

ITEM 46		<u>OVERHEAD DOOR VEHICLE BAY</u>		OH
OHD1	1	O/H DOOR - SEE SPECIFICATION		
ITEM 47		<u>OVERHEAD DOOR COLD STORAGE</u>		OH
OHD2	1	O/H DOOR - SEE SPECIFICATION		

APPENDIX AOPERATIONAL DESCRIPTIONS**ITEM 1
100A****SINGLE DOOR TYPE-A EXTERIOR TO PUBLIC ENTRY VESTIBULE 100**

OPERATIONAL DESCRIPTION FOR THIS DOOR T.B.C. BY DEPARTMENTAL REPRESENTATIVE.

Door is normally closed and locked.

Key from outside of thumb turn from inside retracts and projects deadbolt; Key from outside of thumb turn from inside retracts both latchbolt and deadbolt, trim outside remains locked; trim outside is locked by toggle or projecting deadbolt; trim outside is unlocked by toggle only; and trim inside (when deadbolt is projected) retracts both latchbolt and deadbolt simultaneously and the outside trim remains locked. When locked, access is by key in outside cylinder.

To open the door with the power door operator, the deadbolt must be in the retracted position, then depress the power door operator handicap push buttons to activate the electric strike and power door operator, opening the door. Projecting the deadbolt deactivates the handicap push buttons inside and outside the opening.

The door is always free for egress by turning the inside lever trim and pushing on the door.

**ITEM 3
101****SINGLE DOOR TYPE-E LOBBY 101 TO PRIMARY CORRIDOR 112**

OPERATIONAL DESCRIPTION FOR THIS DOOR T.B.C. BY DEPARTMENTAL REPRESENTATIVE.

**ITEM 15
111A****SINGLE DOOR TYPE-B EXTERIOR TO STAFF VESTIBULE 111**

Door is normally closed and locked. Access is by presenting a valid access card to the card reader or by turning key in the outside key cylinder and opening the door. Door is always free for egress by turning the inside lever handle and opening the door.

Part 1 General

1.1 SECTION INCLUDES

- .1 Glass and glazing for sections referencing this section for Products and installation.
- .2 Frameless Mirrors.

1.2 RELATED SECTIONS

- .1 Section 08 13 13 - Standard Hollow Metal Doors: Glazed doors.
- .2 Section 08 41 13 - Aluminum Framed Entrances And Storefronts.
- .3 Section 08 44 13 - Glazed Aluminum Curtain Walls.
- .4 Section 08 51 13 - Aluminum Windows: Glazed windows.
- .5 Section 08 63 00 - Metal Framed Skylights.

1.3 REFERENCES

- .1 ASTM C1036-06 - Standard Specification for Flat Glass.
- .2 CAN/CGSB 12.1-M90 - Tempered or Laminated Safety Glass.
- .3 CAN/CGSB 12.3-M91 - Flat, Clear Float Glass.
- .4 CAN/CGSB 12.8-97 - Insulating Glass Units.
- .5 CAN/CGSB 12.11-M90 - Wired Safety Glass.
- .6 IGMAC (Insulating Glass Manufacturers Association of Canada) - IGMAC Certification Program for the CGSB 12.8 standard.

1.4 PERFORMANCE REQUIREMENTS

- .1 Provide glass and glazing materials for continuity of building enclosure vapour retarder and air barrier:
 - .1 In conjunction with materials described in Section 07 92 00.
 - .2 To utilize the inner pane of multiple pane sealed units for the continuity of the air barrier and vapour retarder seal.
 - .3 To maintain a continuous air barrier and vapour retarder throughout the glazed assembly from glass pane to heel bead of glazing sealant.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Section 01 31 00: Project management and coordination procedures.
- .2 Preinstallation Meetings: Convene one (1) week before starting work of this section.

1.6 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.

- .2 Product Data on Glass Types Specified: Provide structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- .3 Product Data on Glazing Compounds: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colours.

1.7 QUALITY ASSURANCE

- .1 Perform Work in accordance with GANA Glazing Manual and IGMAC for glazing installation methods.
- .2 Installer Qualifications: Company specializing in performing the work of this section with minimum five (5) years documented experience and approved by the manufacturer.

Part 2 Products

2.1 FLAT GLASS MATERIALS

- .1 Flat Glass (Type FG-A): CAN/CGSB-12.3 M91, Clear 3 mm thick
- .2 Flat Glass (Type FG-B): CAN/CGSB-12.3 M91, Clear, 6 mm thick.
- .3 Tempered Glass (Type FG-C): CAN/CGSB-12.1, clear tempered; 6 mm thick.
- .4 Heat Strengthened (Type FG-D): CAN/CGSB-12.1, Heat Strengthened, 6 mm thick.
- .5 Tempered Glass (Type FG-E): CAN/CGSB-12.1, clear, tempered; 3 mm thick.
- .6 Mirror Glass (Type MR-A); ASTM C1036, Type 1 transparent flat, Class 1 clear, Q2 mirror quality; 6 mm thick, sizes noted on drawings.
- .7 Transparent (One-Way) Mirror Glass (Type MR-B): CAN/CGSB 12.6, float type, laminated, metallic coating applied to tinted glass. 6mm total thickness.
- .8 Wired Glass (Type FG-J): CAN/CGSB 12.11, polished both sides (transparent), woven stainless steel wire mesh style diamond of 13 mm grid size; 6 mm thick.

2.2 LAMINATED GLASS UNITS

- .1 Laminated Glass Units (Type LG-A): CAN/CGSB-12.1-M90, double pane; outer pan of Type FG-C glass, inner pan of Type FG-C glass, 0.06 mm polyvinylbutyral membrane bonded interlayer.
- .2 Laminated Security Glass (Type LG-B); CAN/CGSB-12.1-M90, double pane; outer pan of Type FG-E glass, inner pan of Type FG-E, interlayer of 0.060 mm polyvinylbutyral membrane bonded interlayer. Minimum STC rating of 40. Install glass in neoprene gasket.

2.3 SEALED INSULATING GLASS UNITS

- .1 Insulated Glass Unit for Entrances (Type SG-A): CAN/CGSB-12.8, double pane; outer pan of Type FG-C glass, inner pane of Type FG-C glass; Solarban 60 + Low E Coating on No. 2 surface within unit; 13 mm interpane space filled with argon gas!; with closed cell polymer foam warm edge, seal glass with elastomer; total unit thickness of 25 mm.
- .2 Insulated Glass Unit for Ground Level Windows (Type SG-B): CAN/CGSB-12.8, double pane; outer pane of Type FG-D glass, inner pane of Type FG-B glass; Solarban 60 + Low E coating on No. 2 surface within unit; 13 mm interpane space filled with argon gas; with closed cell polymer foam warm edge, seal glass with elastomer; total unit thickness of 25 mm.
- .3 Insulated Glass Units fro Ground Level Windows (Type SG-C): CAN/CGSB-12.8, double pane, outer pane of Type FG-D glass, inner pane of Type FG-B glass; Solarban 100 + Low E Coating on No. 2 surface within unit, 13 mm interpane space filled with argon gas; with closed cell polymer foam warm edge, seal glass with elastomer; total unit thickness of 25 mm.
- .4 Insulated Glass Units for Skylight (Type SG-D): CAN/CGSB-12.8, double pane, outer pane of Type FG-C glass, inner pane of Type LG-A glass; 13 mm interpane space filled with argon gas.with closed cell polymer foam warm edge; seal glass with elastomer. total thickness of 25 mm.

2.4 ACOUSTIC GLASS UNITS

- .1 Acoustic Insulated Glass Units (Type AG-1): CAN/CGSB-12.8, double pane with special acoustic edge seal; outer pane of Type FG-C glass, inner pane (meeting room side) of Type LG-A; with closed cell polymer foam warm edge seal glass with elastomer; total unit thickness of 31 mm.
- .2 Acoustic Insulated Glass Units (Type AG-2): double pane with special acoustic edge seal; outer pane of Type FG-B glass, inner pane (meeting room side) of LG-A; with closed cell polymer foam warm edge seal glass with elastomer; total unit thickness of 31 mm.
- .3 Edge Seal: metal edge seal; aluminum bent and soldered corners.

2.5 PLASTIC SHEET MATERIALS

- .1 Polycarbonate Security Sheet (Type PS-A): ANSI Z97.1, Plastic compound (GE Lexan); Clear, ultraviolet stabilized; silicone abrasion resistant coating ("Margard" hardcoat technology) for scratch resistance, Clear; 6 mm thick.

2.6 GLAZING COMPOUNDS

- .1 Sealant: in accordance with Section 07 92 00 Joint Sealants.

2.7 GLAZING ACCESSORIES

- .1 Lock Strip Gaskets: ASTM C542, ozone-resistant neoprene compound, with lock-strip (zipper) component that friction-fits into position to retain glass pane/unit, H-shape, tensile strength of 14 MPa tested to ASTM D412, Durometer hardness of 75 tested to ASTM D2240, sized to accommodate glass thickness.

- .2 Setting Blocks: Option I; neoprene or silicone; 80-90 Shore A durometer hardness tested to ASTM D2240, length of 25 mm for each sq m of glazing or minimum 100 mm x width of glazing rabbet space minus 1.5 mm x height to suit glazing method and pane weight and area.
- .3 Spacer Shims: neoprene or silicone, 50-60 Shore A durometer hardness tested to ASTM D2240, minimum 75 mm long x one half the height of the glazing stop x thickness to suit application. Self adhesive on one face.
- .4 Glazing Tape: Preformed butyl compound with integral resilient tube spacing device; 10-15 Shore A durometer hardness tested to ASTM D2240; coiled on release paper; INSERT VALUE mm size; black colour.
- .5 Glazing spline: ASTM C864, Option I, Resilient H-shaped extruded shape to suit glazing channel retaining slot; black colour.
- .6 Glazing Clips: Manufacturer's standard type.
- .7 Smoke Removal Unit Targets: Adhesive targets affixed to glass to identify glass units destined for removal for smoke control.
- .8 Glazing Security Film: Security laminate constructed with multiple plies of premium grade Biaxially-oriented polyethylene terephthalate (BoPET), accepted manufacturer: ACE. Apply film after glazing is installed. Locate on interior glass side, 25 mm from perimeter edge.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that openings for glazing are correctly sized and within tolerance.
- .3 Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and ready to receive glazing.

3.2 PREPARATION

- .1 Clean contact surfaces with solvent and wipe dry.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .3 Prime surfaces scheduled to receive sealant.
- .4 Install sealant in accordance with manufacturer's written instructions.

3.3 GLAZING METHODS

- .1 Verify that selected sealants and glazing tapes are compatible.
- .2 Perform glazing as required by frame manufacturer to achieve specified performance criteria.

- .3 Completed exterior glazed assemblies to provide full perimeter air and vapour seal to the glazed frames and be pressure equalized.

3.4 CLEANING

- .1 Section 01 74 00: Cleaning installed work.
- .2 Remove glazing materials from finish surfaces.
- .3 Remove labels after Work is complete.
- .4 Clean glass and adjacent surfaces.

3.5 PROTECTION OF FINISHED WORK

- .1 Section 01 78 40: Protecting installed work.
- .2 After installation, mark pane with an 'X' by using removable plastic tape or paste. Do not mark heat absorbing or reflective glass units.

END OF SECTION

41.3

31.8

0.455

- .3 A non-load bearing (non-structural) member is defined as a member in a steel-framed system which is limited to transverse (out-of-plane) load of not more than 480 PA, a superimposed axial load, exclusive of sheathing materials, of not more than 1460 N/m, or a superimposed axial load of not more than 890 N.
- .4 A load bearing (structural) stud may be used in a non-load bearing application; however, non-load bearing members (studs or track) may never be used in a load bearing (axial and/or wind loading) applications.
- .5 Track for interior walls and non-load bearing walls located at exterior walls shall have a thickness of not less than the thickness of the corresponding studs and shall have not less than 31.8 mm flanges.
- .6 Calculate structural properties in accordance with CSA-S136.
- .7 Space members not to exceed 610mm (24") o.c.
- .8 The required depth of steel studs is shown on the drawings. Do not use other sizes unless approved by the Department Representative.
- .9 Design components to accommodate specified erection tolerances of the structure.
- .10 Connect steel framing members by sheet metal screws, welding or crimping.
- .11 Design steel studs to take into account the anchorage of other materials being supported including but not limited to: sub girts supporting metal cladding and composite panels, soffit finishes and the provision of lateral support at window heads.
- .12 Design steel studs to support equipment where detailed. Obtain design loads from equipment supplier.

1.6

SUBMITTALS

- .1 Submit shop drawings and samples in accordance with Section 01 33 00 Submittals.
- .2 Submit two (2) certified copies of mill reports covering chemical and mechanical properties, and coating designation of steel used in this work.
- .3 Submit samples of all framing components and fasteners to the Department Representative if requested.
- .4 Do not construct work until all submittals are reviewed.

1.7 QUALIFICATIONS

- .1 Installer: company specializing in light-gauge steel stud work with five (5) years proven experience for projects of similar size and complexity.
- .2 Manufacturer: use products and materials from same source for entire project.

Companies engaged in welding shall be certified by the Canadian Welding Bureau to CSA W47.1 and welders qualified for the base material and procedures to be executed.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Non-load bearing Steel Framing, General
 - .1 Steel sheet components shall comply with ASTM C645 requirements for metal, unless otherwise indicated.
 - .2 Steel for non-load bearing members shall have metallic coatings that conform to ASTM A653M or ASTM A792M with minimum metallic coating weights (mass) of Z120 and AZM150 respectively. Alternative coatings shall be permitted to be used if proven to have equivalent corrosion protection.
 - .3 Framing members shall comply with the AISI North American Standard for Cold-Formed Steel Framing (Product Data) for conditions indicated.
- .2 Suspension System Components
 - .1 Tie wire shall comply with ASTM A641/A641M zinc-coated, soft-annealed, 1.21 mm minimum diameter, or of a material and size having equivalent corrosion resistance and strength.
 - .2 Hanger attachments to concrete:
 - .1 Anchors shall be fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers, to meet ASTM E488.
 - .2 Power-actuated fasteners, suitable for application indicated, shall be fabricated from corrosion-resistant materials with clips or other devices for attaching hangers, to meet ASTM E1190.
 - .3 Hanger wire shall comply with ASTM A641/A641M zinc-coated, soft-annealed, 3.77 mm minimum diameter, or of a material and size having equivalent corrosion resistance and strength.
 - .4 Carrying Channels
 - .1 Channels shall conform to ASTM C754 and shall be cold-firmed from steel with minimum 228 MPa yield strength and 1.37 mm base steel thickness.

- .2 Channels shall have a minimum coating of Z120 galvanizing in accordance with ASTM A653/A653M. Other coatings (eg. Aluminum-zinc alloy to ASTM A792/A792M) providing Equal or better corrosion protection may also be used.
- .3 Carrying channels shall have minimum 12.7 mm wide flanges and minimum depth of 38 mm.
- .5 Furring Members
 - .1 Furring channels shall comply with the AISI North American Standard for Cold-Formed Steel Framing (Product Data) and shall have a minimum base steel thickness of 0.455 mm and with minimum 12.7 mm wide flanges and a depth of 19.1 mm.
 - .2 Steel stud shall be manufactured from steel in accordance with the AISI North America Standard for Cold-Formed Steel Framing (Product Data) and shall have a minimum base Steel thickness of 0.455 mm and a depth as indicated on drawings.
 - .3 Hat-shaped, rigid furring channels shall comply with the AISI North American Standard for Cold-Formed Steel Framing (Product Data) and shall have a minimum base steel thickness of 0.455 mm and minimum depth of 22.2 mm. The minimum width of furring attachment flanges shall be 12.7 mm.
 - .4 Resilient furring channels are designed to reduce sounds transmission and shall have a minimum depth of 12.7 mm.
- .3 Steel Framing for Framed Assemblies
 - .1 Steel studs and track shall be in accordance with the AISI North American Standard for Cold-Formed Steel Framing (Product Data) and shall have minimum base steel thickness of 0.455 mm.
 - .2 Slip-Type Head Joints: Where indicated, provide one of the following:
 - .1 Deflection Track: steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and width to accommodate depth of studs.
 - .2 Single Long-Leg Track: track complying with the AISI North American Standard for Cold-Formed Steel Framing (Product Data) with 50.8 mm deep flanges in thickness not less than indicated for studs, installed with studs friction-fit into top track and with continuous bridging located within 305 mm of the top studs to provide lateral bracing.
 - .3 Double-Track System: track complying with AISI North American Standard for Cold-Formed Steel Framing (Product Data), inside track with 50.8 mm deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction fit inside track.
 - .3 Flat Strap and Backing Plate
 - .1 Sheet steel for blocking and bracing in length and width indicated.
 - .2 Minimum base steel thickness is 0.455 mm.

- .4 Channel bridging shall comply with the AISI North American Standard for Cold-Formed Steel Framing (Product Data) and shall have a minimum base steel thickness of 0.455 mm with minimum 12.7 mm wide flanges and depth of 19.1 mm.
- .5 Hat-shaped, rigid furring channels shall comply with the AISI North American Standard for Cold-Formed Steel Framing (Product Data) and shall have minimum base steel thickness of 0.455 mm, a minimum depth of 22.2 mm. The minimum width of furring attachment flanges shall be 12.7 mm.
- .6 Resilient furring channels are designed to reduce sound transmission and shall have a minimum depth 12.7 mm.
- .7 Furring channels shall comply with the AISI North American Standard for Cold-Formed Steel Framing (Product Data) and shall have a minimum base steel thickness of 0.455 mm and with minimum 12.7 mm wide flanges and a depth of 19.1 mm.
 - .i Furring Brackets: adjustable, corrugated-edge of steel sheet with minimum base steel thickness of 0.79 mm.
 - .ii Tie wire shall comply with ASTM A641/A641M zinc-coated, soft-annealed, 1.21 mm minimum diameter, or of material and size having equivalent corrosion resistance and strength.
- .8 Z-shaped Furring: with slotted web or non-slotted web, face flange of 31.8 mm, wall attachment flange of 22.2 mm, and depth steel thickness of 0.455 mm, and depth required to fit insulation thickness indicated.
- .4 Fasteners for Metal Framing: of type, material, size, corrosion resistance, holding power and other properties required to fasten steel members to substrates in accordance with ASTM C1002.
- .5 Isolation strip at exterior walls: provide one of the following:
 - .1 Asphalt-saturated organic felt: ASTM D226, Type 1 (no. 15 asphalt felt), perforated.
 - .2 Foam gasket: adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 3.2 mm thick, in width to suit steel stud size.
- .6 Welding Materials: to CSA W59.
- .4 Screws: #8 or heavier, 11 mm dia. pan head, self-drilling, case hardened, self-tapping sheet metal screws, 0.008 mm coating of zinc or cadmium plating. Screw length equal to thickness of materials penetrated plus not less than 12 mm penetration of the stud. Use not less than 10 mm pan head self-drilling, self-tapping screws for fastening studs to track.
- .5 Anchors: concrete expansion anchors or other suitable drilled type fasteners, as selected by steel stud design engineer.

- .6 Bolts, nuts, washers: hot dipped galvanized to CSA G164, 600 g/m² zinc coating.
- .7 Touch-up primer: zinc rich, to CGSB 1-GP-181M.
- .8 Insulation for deflection channel: Fibreglass AF220 or approved alternative.
- .9 Sound Seal - 6 x 18 mm urethane foam sealing strip, self-adhesive. At intersecting walls and tracks to floor and ceiling where sound insulated walls indicated on drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Examine the work of other sections upon which the work of this section depends and report any discrepancies to the Department Representative.
- .2 Verify that surfaces and conditions are ready to accept the work of this section.
- .3 Beginning of installation means acceptance of existing conditions.

3.2 ERECTION

- .1 Install steel stud framing in accordance with Section 9.8 of the AWCC Manual and as follows:
- .2 Erect components to requirements of engineered shop drawings.
- .3 Anchor tracks securely to the structure at 800 mm o.c. max., unless lesser spacing prescribed on shop drawings.
- .4 Set tracks on foam seals as detailed.
- .5 Erect studs plumb, aligned and securely attached with not less than one No. 8 screw or welded at each side of the flange of the top and bottom tracks.
- .6 Seat studs into top and bottom tracks.
- .7 Install slotted deflection channel at top of walls where required to accommodate vertical deflection, in strict accordance to manufacturer's instructions.
- .8 Install studs at not more than 50 mm from abutting walls, openings, and each side of corners and terminations with dissimilar materials.
- .9 Unless the engineering design for the steel stud wall assembly provides for lateral stiffening by means other than internal bridging, brace steel studs with horizontal internal bridging at 1200 mm o.c. max. for masonry veneer and 1500

mm max. for other material. Fasten bridging to 1.52 mm steel clips fastened to steel studs with four (4) No. 8 screws or by welding. Touch-up welded areas with coat of galvanized paint.

- .10 Frame all openings in stud walls to adequately carry loads by the use of additional framing members and bracing as detailed on shop drawings. Provide a minimum of double 20 gauge studs to each side of door openings, full height of wall.
- .11 Frame perimeter of openings to accommodate access panels, light fixtures, diffusers, and grilles to support loads of these items.
- .12 Provide 1.22 mm sheet metal backing in walls for anchoring and mounting equipment, hardware, washroom accessories, fittings and fixtures where not supplied with backing attachments and not detailed for wood blocking by Section 06 10 00 Carpentry. All equipment, hardware, fixtures, fittings and anchors shall be fastened to blocking or backing in the partitions.
- .13 Penetrate sheet metal screws a minimum of three (3) exposed threads beyond joined materials.
- .14 Perform welding work in accordance with CSA W59 and/or ANSI/AWS D1.3 whichever is applicable.
- .15 Touch-up welds with coat of zinc rich primer.

3.3 ERECTION TOLERANCES

- .1 Plumb: not to exceed 1/500th of the member length.
- .2 Camber: not to exceed 1/1000th of the member length.
- .3 Spacing: not more than 3 mm from design space.
- .4 Gap between end of stud and track web: not more than 4 mm except where required to accommodate deflection.

3.4 CUTOUTS

- .1 Limit unreinforced cutouts for services to the following dimensions:

Member	Depth Across Member	Depth Along Member Length	Spacing O.C.
89 mm	38 mm	100 mm	600 mm
150 mm	64 mm	114 mm	600 mm
- .2 Limit the distance from the centerline of the last unreinforced cutout to the end of the member to less than 300 mm.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

- .1 The work of this section comprises the furnishing of all labour, materials and equipment required for the supply and installation of all interior and exterior Gypsum Wallboard and accessories to walls and ceilings plus furring channels as shown on the drawings and/or specified herein.
- .2 Supply and install all sound insulations and sealants to gypsum wallboard walls shown.
- .3 Co-operate with carpentry trade who will set all wood grounds and blocking.
- .4 Caulking and sealing around openings and up into steel deck flutes to maintain fire ratings of walls where required.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- .1 Carpentry - wood backing and blocking for millwork, door stops, etc. Section 06 10 00
- .2 Insulation standards and thermal insulations Section 07 20 00
- .3 Caulking and Sealant standards (fire and sound sealing) Section 07 90 00
- .4 Hollow Metal Doors & Frames Section 08 10 00
- .5 Metal Stud Systems Section 09 22 00
- .6 Room Finish Schedule Section 09 06 00
- .7 Painting Section 09 90 00

1.3 REFERENCE STANDARDS

- .1 Materials and work to CSA A82.30 and A82.32 except when specified otherwise herein.

1.4 GUARANTEE

- .1 This contractor shall guarantee his work as to labour and workmanship for a period of one year after the date of Substantial Completion. Any nail pops, shrinkage cracks, etc., shall be repaired and refinished including painting at no additional cost to the Department Representative.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Gypsum Wallboard - to ASTM C36 and CAN/CSA-82.27.M91, 12.5 mm (nominally 12) or 15.9 mm (nominally 15), standard or Type 'X' as indicated on drawings and required for fire rating, tapered edges, paper faced. Note: one hour fire rated structural steel wall assembly to comply with CGC fire test for ULC Design No. W424.
- .2 Abuse Resistant Gypsum Board - where indicated on drawings or specified, to CSA A82.27-M, ASTM C36 and C1396. 15.9mm thickness; standard sheet sizes 1220mm wide x 2440 to 3660 length.
- .3 Tile Backer Wallboard - to ASTM C1178, 12mm or 15 mm (where required to match adjacent surfaces), to wet locations only (i.e. shower areas). Standard gypsum is an acceptable backing for ceramic tile in non-wet areas.
- .4 Screws to ASTM C646-72 type S - No. 6 x 30 mm for single thickness to steel stud application, power drilling, self-tapping case hardened, socketed countersunk head, rust-resistant type.
- .5 Resilient furring channel - "Sound Bar" - 0.50 mm galvanized steel, 63 x 13 mm.
- .6 Runner or carrying channels - cold formed 18 gauge mild steel 37 x 18 mm.
- .7 Tie wire - 16 gauge soft, annealed wire.
- .8 Corner and casing beads, and base screeds, to CSA A82.30. Commercial grade sheet steel with G90 zinc galvanized to ASTM A525-71. Type forming self screed for joint filler.
- .9 Reinforcing Tape - 50 mm wide perforated, purpose made.
- .10 Gyproc joint filler and topping cement to ASTM C475-64 (1975).
- .11 Adhesive - for laminating wallboard to wallboard, as recommended by wallboard manufacturer. Waterproof organic type gun applied to ASTM C557, and compliant with VOC criteria for LEED credit EQ 4.1.
- .12 Drywall Suspension System - at suspended drywall ceilings and where indicated on the drawings shall be a pre-engineered system consisting of galvanized straight main tees along with straight furring cross channels or cross tees including all accessories as required for a complete installation; USG Drywall Suspension System or approved equal.

PART 3 EXECUTION

3.1 SUSPENDED CEILINGS & FURRING

- .1 Furring units to be 610 mm o.c. or as noted on drawings.
- .2 Use galvanized supports and anchors to all locations.
- .3 Tie components together with double wire ties.
- .4 Make allowance for thermal and dimensional movement. Maintain clearance to avoid transmission of structural loads to vertical furring.
- .5 Frame openings and around built-in equipment, cabinets, access panels, etc., on 4 sides, with channels, extend furring into reveals. Check clearance with respective equipment suppliers. Furr around pipes and ducts and form bulkheads between ceilings at different levels.
- .6 Where fixtures, air supply diffusers and plaster rings are to be supported on framing provide hangers to support them to prevent sagging.
- .7 Mitre furring around all corners. Form mitres by cutting the flanges and bending the web. Do not cut the web to form corners.
- .8 Do not install gypsum board ceiling framing until after ducts, pipes and conduit are in place.
- .9 Runner channels shall be 900 mm o.c. maximum and rod hangers shall be 1220 mm maximum.
- .10 Level runners to maintain tolerance of 3 mm in 3600 mm. Tolerance not to be cumulative. Locate runners at change in direction in ceilings.
- .11 Frame with furring channels, perimeter of openings to accommodate access panels, light fixtures, diffuser grills and to support the loads of these items and the runner channels and finishes.

3.2 DRYWALL SUSPENSION SYSTEM

- .1 Install in accordance with manufacturer's current printed recommendations.
- .2 Do not support hanger wires from mechanical or electrical equipment..

3.3 APPLICATION OF FURRING CHANNELS

- .1 All resilient furring channel shall be applied to walls designated at 610 o.c. horizontally using 30 mm drywall screws. A 90 x 12 mm gypsum filler strip shall be used as backing at the base of wall and at openings. Top resilient furring channel shall be located 150 mm from ceiling.

3.4 SOUND INSULATION

- .1 Completely fill sound walls with fiberglass blankets, run continuously from floor to ceiling of structure, over door frames and openings and around corners.
- .2 Pack sound insulation around cut openings in wallboard, behind outlet boxes around plumbing, heating or structural items passing through the system and at abutting walls.
- .3 Secure blankets by adhesive or staples if friction fit is not sufficient.
- .4 Ensure flutes of steel decks adjoining sound rated partitions are insulated and sealed with purpose made neoprene fillers.
- .5 Seal around all openings adjacent door and window frames and around wall perimeters including at neoprene fillers with beads of sound sealant specified.

3.5 APPLICATION WALLBOARD

- .1 **NOTE: DO NOT INSTALL WALLBOARD UNTIL ALL WOOD BACKING AND BLOCKING HAS BEEN INSTALLED. TAKE SPECIAL NOTE OF BACKING FOR SURFACE MOUNTED HARDWARE; DOOR STOPS, GRAB BARS, ETC. NOTIFY DEPARTMENT REPRESENTATIVE FOR REVIEW PRIOR TO INSTALLING WALLBOARD.**
- .2 Erect wallboard and tape joints to CSA A82.31 except where specified elsewhere. Wallboard installation to structural stud walls to conform to ULC Design No. 424 in all respects.
- .3 Attach wallboard to framing using screws at 200 mm o.c. to perimeters and 300 mm o.c. to field except as required by ULC Design No. W424.
- .4 Install wallboard using single layer application unless indicated otherwise on drawings. On double layer application stagger joints.
- .5 Erect wallboard vertically full height or horizontally with vertical joints occurring at windows or door openings. Do not force board joints into position.
- .6 All joints shall occur over framing members. Allow 2 mm to 3 mm space between butted ends.
- .7 Generally all outside corners shall be constructed with factory edges and shall be within 3 mm of flush. If corner is not square notify Department Representative.
- .8 Cut board to fit within 3 mm of fixtures outlet boxes, etc. Larger gaps shall not be closed using filler only.
- .9 Note all vertical and horizontal joints in fire separations having a fire resistance rating shall be offset by minimum 610 mm.

3.6 ACCESSORIES; METAL BEADS, ETC.

- .1 Erect accessories straight, plumb or level, rigid and at the proper places. Secure at 225 o.c. maximum. Use full length pieces to minimize joints. Where runs must be made up of more than one piece, fit lengths together tightly, accurately align and rigidly secure each side of joint. Mitre and fit corners accurately, free from rough edges.
- .2 Install corner beads on all external corners.
- .3 Install casing bead at all junctions with dissimilar materials, where board butts against surface having no trim concealing the junction and where shown on the drawings.
- .4 Install access doors to electrical and mechanical fixtures as specified and supplied by those trades.
- .5 Do all cutting, patching and making good to existing drywall and plaster surfaces and as required by the installation of work of other trades. .

3.7 FINISHING

- .1 Finish to the following:
 - .1 Mechanical/ Electrical Rooms - Level 1
 - .2 Storage & Janitor's Rooms - Level 3
 - .3 All other areas - Level 5
- .2 Mix joint compound in accordance with manufacturer's specifications.
- .3 Fill all joints and screw nail depressions with three (3) coats of joint compound. Allow preceding coat to set before applying subsequent coat.
- .4 Reinforcing tape shall be applied over a thin coat of joint compound. Cover all edges of tape with a thin coat of joint compound.
- .5 Neatly crease tape and apply at all interior corners.
- .6 Apply joint compound over the flanges of all corner beads and casing beads flush with nose of the bead and extending at least 75 mm onto the surface of the board.
- .7 After bedding coat has set, apply a second coat of joint compound feathered at least 150 mm on each side of butt joints and 100 mm past the flanges of all beads.
- .8 After the second coat has set, apply a third coat of joint compound and feather to 200 mm on each side of butt joints and 125 mm past the flanges of all beads.
- .9 Feather all coats of joint compound onto adjoining surfaces so that all joints, tape, holes and flanges of beads are invisible and so that the camber is 1.5 mm maximum.

- .10 Sand to smooth true flat surface.
- .11 Review all drywall surfaces after base coat of paint has been applied and touch up all unsatisfactory conditions..

END OF SECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

- .1 The work of this section comprises the furnishing of all labour, materials and equipment required for the supply and installation of all clay and ceramic tile floor and wall finishes as shown on the drawings and/or herein specified, including toppings to concrete slabs to obtain the required slopes and other preparation of surfaces on which this work depends plus sealing to tile.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- .1 Glass and Glazing - Mirrors Section 08 80 50
- .2 Gypsum Wallboard - tile backer wallboard Section 09 29 00
- .3 Resilent Flooring – reducer Section 09 65 10

1.3 QUALITY ASSURANCE

- .1 Do tile work in accordance with the 2009/2010 Specification Guide 09 30 00 - Tile Installation Manual, produced by Terrazzo Tile and Marble Association of Canada (TTMAC), except where specified elsewhere.
- .2 Note that all the floors shall have a positive slope to drains. Ensure subfloor meets this requirement.
- .3 Submit duplicate samples of colours, textures, size and pattern of tile to be supplied for this project when requested by Department Representative.
- .4 Deliver and store packaged materials in original unopened containers, dry and free from marring or chipping.
- .5 Air temperatures at tile installation area shall be minimum 14oC (55oF) for 72 hours prior to, during and after installation..

1.4 GUARANTEE

This Contractor shall guarantee his work as to labour and workmanship for a period of one (1) year after the date of the Department Representative's Certificate of Substantial Completion.

1.5 SAMPLES

- .1 When requested by the Department Representative submit 20mmx20mm or 30mmx30mm samples of complete colour range and finish options for colour and finish selection, and submit three (3) 300mmx300mm pieces for each colour selected.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Porcelain Tile Series: Standard of Acceptance is “Design Evolution” series by Cercom, through-body porcelain with format tile and mosaic tile (dimensions specified below); glazed finish for walls, unglazed R-9 to R-12 for floors; complete with tile cove base and all trims and fittings. “Durastone” series by Ames, and “Globe 1.0” series by Floor Gres are pre-approved alternates. Allow 10-12 weeks delivery.
- .2 Products Data:
- | | |
|---|--|
| Tile Thickness | 8mm |
| Moisture Rating | MR4 |
| Shade Variation | V1-V2 |
| Wear Resistance (PEI) | Class 4 - Class 5 |
| Coefficient of Friction | R9 - R12 (floors) |
| Abrasion Resistance | less than or equal to 175mm ³ |
| Moduls of Rupture and Breaking Strength | S greater than or equal to 1300N
R greater than or equal to 35N/mm ² |
| Resistance to Chemical Attack | Class UA-ULA-UHA |
| Variation in Length / Width | +/- 0.5% |
| Resistance to Stains | no visible alterations |
| Colour Resistance to Light | no notable colour change |
| Breaking Strength (ANSI A137.1) | greater than or equal to 250lb |
| Water Absorption (ASTM 373) | 0.05% |
| Resistance of Surface Abrasion | greater than or equal to 400 (ASTM C1243) |
- .3 Shower and Adjacent Washroom (Room 117):
- .1 Porcelain Mosaic, 30mm x 30mm mosaic tile in 300mm x 300mm sheets; 8mm thickness; Glazed for shower walls, and unglazed finish with minimum R-9 slip coefficient for floor mosaic; complete with cove base,

trim pieces, etc. conforming to CAN/CGSB-75.1-M88: Type 5, Class MR4.

- .2 Allow for accent band to perimeter of tiled walls. Colour to be different from wall tile. Colours to be chosen by Department Representative from manufacturer's full standard colour range. Allow for 10% accent colour tile selected from premium colour range.

.4 Locker Room and Washrooms:

- .1 Porcelain Tile, 100mm x 100mm tile or 30mm x 30mm mosaic tile in 300mm x 300mm sheets, 8mm thickness, glazed for walls and unglazed for floors R9 minimum, complete with tile cove base and all fittings; conforming to CAN2-75.1-M77: Type II, Class MR2; Colours to be chosen from manufacturer's range of standard colours. Allow 10% accent colour tile selected from premium colour range.
- .2 Allow for accent band to perimeter of tiled walls. Colour to be different from wall tile. Colours to be chosen by Department Representative from manufacturer's full standard colour range. Allow for 10% accent colour tile selected from premium colour range.

.5 Vestibules and Lobby:

- .1 Porcelain Tile, 300mm x 600mm; 8mm thickness; unglazed R-9 minimum, complete with 100mm x 300mm tile cove base and all fittings. conforming to CAN2-75.1-M77: Type II, Class MR2-MR4. Colours to be chosen from manufacturer's range of standard colours.
- .2 Allow for accent band to perimeter of tiled floor. Colours to be chosen by Department Representative from manufacturer's full standard colour range. Allow for 10% accent colour tile selected from premium colour range.

- .6 Mortar: Laticrete 4237 with 211 Crete Filler powder, Crest Cement Thinset or approved equal, Organic Adhesive: to USA-S1-A136-1 and CGSB71-GP-22.

- .7 Cement: Portland White to CSA A5; 1974, Symbol 10.

- .8 Water: Potable.

- .9 Dry Set Mortar: to ANA A118.1 - "Crest Cement Thinset" or approved alternate.

- .10 Organic Adhesive: to USA-S1-A136-1 and CGSB 71-GP-22.

- .11 Grout: to meet or exceed ANSI 118.3 standards; pre-mixed urethane based non-allergenic, sanded grout for ceramic, porcelain, and natural stone on floors and walls. Stain-resistant. Water soluble. 4,000psi compression strength. Quartz-Lock (TM) grout, or approved equal.

- .12 Sand: to CSA A82.56-1950, sharp, clean and screened.

- .13 Hydrated Lime: to CSA A84.43-1950, ASTM C206 or C027, Type S.

- .14 Decorative Wall Corner Trim: Extruded aluminum to ASTM B221, 6463-T5 Alloy; lateral trapezoidal-perforated anchoring leg, as follows:
 - .1 Length: to suit location
 - .2 Height: to suit tile thickness
 - .3 Product and finish: Stainless Steel, Brushed, Schlüter-Quadec-E

- .15 Shower Waterproofing System - for built-in tiled showers: (Room 117)
 - .1 Membrane
 - .1 Standard of Acceptance: Schluter®-KERDI or approved equal.
 - .2 Description: 0.008 inch (0.2 mm) thick, orange polyethylene membrane, with polypropylene fleece laminated on both sides, which is listed by cUPC® to meet or exceed requirements of the American national standard specifications for load bearing, bonded, waterproof membranes for thin-set ceramic tile and dimension stone installation A118.10.
 - .2 Drain Assembly
 - .1 Standard of Acceptance: Schluter®-KERDI-DRAIN
 - .2 Description: floor drain 11-25/32 inch (300 mm) diameter, trapezoid-perforated, integrated bonding flange with polypropylene fleece thermally laminated to the surface and hubbed connection to 2 inch (50 mm) drain pipe. Grate assembly includes 4 inch x 4 inch (102 mm x 102 mm) square grate, height adjustment collar, and lateral adjustment ring with trapezoid perforations. Drain listed by UPC® to meet requirements of "International Association of Plumbing and Mechanical Officials Interim Guide Criteria for Floor Drain with Integrated Bonding Flange" (IGC 195), listed by CSA to meet requirements of the Canadian Standards Association standard, "Floor, Area, and Shower Drains, and Cleanouts for Residential Construction" (CSA B79), and referenced in method B422 of the Tile Council of North America Handbook for Ceramic Tile Installation.
 - .3 Drain Housing Material: ABS
 - .4 Grate Material and Finish - Stainless Steel Type 304 = V2A
 - .3 Shower Base:
 - .1 Standard of Acceptance: Schluter®-KERDI-SHOWER-ST

- .2 Description: trapezoid-imprinted, prefabricated, sloped tiled shower tray base, made of 2.75 lb/ft³ (44 kg/m³) density, self-extinguishing (HF-1 rating per UL-94) expanded polystyrene, with 12-5/16 inch (313 mm) diameter removable recessed section with 1/8 inch (3 mm) wide ribs on top and channels on the underside.
- .3 Size: to suit details on drawings.
- .5 Sealing and Bonding Compound:
 - .1 Standard of Acceptance: Schluter®-KERDI-FIX
 - .2 Description: single-component, elastomeric, waterproof sealing and bonding compound with a silane-modified polymer base. Compound is free of solvents and odorless.
 - .3 Color - BW - Bright White.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

- .1 Examine all surfaces and report any unsatisfactory conditions to the Department Representative. Note that backing to tile walls shall be "Dens-Shield" as Section 09 29 00.
- .2 Do not commence work until surfaces and site conditions are satisfactory. Starting of work shall imply acceptance of the surface.
- .3 Surfaces shall be clean, dry, hard, structurally sound, plumb and true to plane.
- .4 Do not start work until work of other trades which is to be in or behind the tile has been installed and approved.

3.2 WORKMANSHIP AND INSTALLATION - GENERAL

- .1 Supply and install such levelling coats or underbeds so as to achieve the tolerances of 3 mm in 2400 mm.
- .2 Apply tile or backing coats to warm frost free surfaces.
- .3 Fit tile units around corners, fitments, fixtures, drains and other built-in objects to maintain uniform joint appearance. Make cut edges smooth, even and free from chipping. Edges resulting from splitting not acceptable.
- .4 Make joints between tiles uniform, aligned, and approximately 1.5 mm wide for ceramic tile, plumb, straight and true, even and with adjacent tiles flush.
- .5 Align patterns. Ensure sheet layout not visible after installation of ceramic tile.

- .6 Lay out tiles so that perimeter tiles are minimum 1/2 size.
- .7 Sound tiles after setting and replace hollow sounding units to obtain full bonds.
- .8 Make internal angles square, external angles bullnosed. Use surface cap tiles to achieve bullnose effect.
- .9 Use surface cap or trim tiles at termination of tile panels except where panel butts a projecting surface of differing plane.
- .10 Co-ordinate tile and frameless mirror installation. Frameless mirrors are to be installed directly to gypsum board backing and sized to fit the tile course to provide a recessed mirror.

3.3 INSTALLATION

- .1 Install tile to TTMAC details most suitable to substrate materials and conditions found.
- .2 Generally, wall tiles to TTMAC detail 200-5-B. Floor tiles to detail 200-15.

3.4 CLEAN-UP AND SEALING

- .1 Promptly as work proceeds, and on completion, clean tiles of excess grout and adhesives according to manufacturer's recommended procedures.
- .2 When tile work is clean and grouting fully cured, apply 2 coats penetrating sealer, 16 square meters per litre per coat, all to tile and sealer manufacturer's recommended procedure.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

- .1 The work of this section comprises the furnishing of all labour, materials and equipment required for the supply and installation of all acoustical ceiling work as shown on the drawings and herein specified.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- .1 Gypsum Board - bulkheads Section 09 29 00
.2 Mechanical Grills and Diffusers Division 25
.3 Electrical Division 26

1.3 GUARANTEE / WARRANTY

- .1 This contractor shall guarantee his work as to labour, materials and workmanship for a period of one (1) year after the date of Substantial Completion.
.2 Provide manufacturer's written 30 year system warranty against ceiling tile sag for environmental conditions up to 40 degrees C, and up to 95% Relative Humidity.

1.4 STANDARDS

- .1 Provide materials and installation to meet fire ratings of assemblies as required by NS Building Code and indicated on drawings.
.2 Ceiling tile:
.1 ASTM E1264 Classification;
.2 Can/ULC S102 Surface Burning Characteristics - class A; Flame Spread 25. Smoke Developed: 50
.3 Installation - 2005 National Building Code for seismic requirements to the satisfaction of the authority having jurisdiction, and shall conform to ASTM-C635, C636 and ASTM-E580-96.
.4 Installers shall have minimum 5 years experience.

PART 2 - Products

2.1 MATERIALS

- .1 T-bar Suspension System
Description: Two-directional exposed T-bar grid. Commercial quality cold rolled steel zinc coated, shop painted satin sheen, white die cut interlocking

components, main and cross tee of double web with rectangular bulb, depth governed by span, all components 25 mm exposed face. Intersections to be flush faced.

- .2 Hangers - 3.6 mm diameter (12 gauge) galvanized soft steel wire.
- .3 Hanger Isolator - 25mm, with rated loads and spring selection in accordance with manufacturer's design tables.
- .4 Suspension Accessories - wall angles, splices, blue steel retainer clips, etc. to complement suspension systems and meet code requirements.
- .5 Ceiling Tile:
 - .1 Standard Ac Tile: Mineral Tile, fine-textured, non-fissured; 610 mm x 610 mm x 16 mm thick; (24" x 24" x 5/8") SLT edge profile; Class A; NRC .55; CAC Min. 35; Light Reflectance .86; colour white; 65% recycled content; Low VOC emissions; anti-mould and mildew treatment.
 - .2 Moisture resistant Ac Tile: suitable for wet environment required in Staff Shower (117). Moisture and mold resistant, sag resistant; medium texture, white colour. Edge profile square. CAC minimum up to 20. Light reflectance 0.76. NRC 0.50; Recycled content 31%. 610mmx610mmx16mm (24" x 24" x 5/8"). Fibreglass basemat with washable vinyl surface.

PART 3 – Execution

3.1 JOB ENVIRONMENT

- .1 Do not commence installation until building is enclosed and dust generating activities completed.
- .2 Wet work (drywalling, etc) to be dry prior to commencement of installation.
- .3 Require uniform minimum temperature of 16°C and humidity of less than 20-40% prior to, during and after installation.

3.2 INSTALLATION OF CEILINGS

- .1 Install suspension assemblies to manufacturer's written instructions and in accordance with ASTM E580. Perfectly level using laser or transit.
- .2 Ensure suspended system is coordinated with location of related components and ceiling grid established on drawings. (Refer to reflected ceiling plan, electrical and mechanical plans.)
- .3 Do not erect ceiling suspension system until anchors, blocking, fire or sound barriers, electrical and mechanical work above ceilings are inspected and approved.

- .4 Install acoustic units parallel to building lines with edge unit not less than 50% of unit width.
- .5 Install flush edge moulding at junction of acoustic unit ceiling and other building components. Secure to construction. Butt joints tightly, neatly, square and true in alignment.
- .6 Support suspension system main runners at 1220 mm o.c. maximum with hanger wire from building structural system, not the steel deck if ULC rated system does not allow. Install additional hangers as required to support super-imposed loads; recessed electrical fixtures, heating grilles, etc. Provide additional support above main runner where spacing of hanger wires exceeds 1220 mm o.c. due to duct work, etc. Maximum permissible deflection is 1/360 of span.
- .7 In addition to the vertical support wires at 3660 mm centers in both directions install hanger wires in 4 directions splayed at 45° to vertical wires to provide seismic restraint.
- .8 Interlock cross members to main runners to provide rigid assembly.
- .9 Install retainer clips to all tiles over partitions and/or as required to meet fire ratings.
- .10 Install mineral fibre panels over entire areas as shown in plans and details. Scribe acoustic units to fit adjacent work without gaps.

3.3 CLEANING

- .1 Keep acoustic installation and all components clean. Remove blemishes and replace damaged units prior to final acceptance.

3.4 MAINTENANCE MATERIALS

- .1 Turn over to the Department Representative additional acoustic lay-in ceiling tile units equal to 2% of the total quantity used of each type, for maintenance purposes. Such quantities shall not be used for clean up purposes prior to completion of job.

PART 1 GENERAL

1.1 SCOPE OF WORK

- .1 The work of this section is comprised of the furnishing of all labour, materials and equipment for complete installation of resilient flooring and all rubber bases including to millwork, and carpet as indicated on drawings and herein specified.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- | | | |
|----|---------------------------|------------------|
| .1 | Cast-in-Place Concrete | Section 03 30 00 |
| .2 | Architectural Cabinetwork | Section 06 41 11 |
| .3 | Carpet Tile | Section 09 68 13 |

1.3 QUALITY CONTROL

- .1 Submit samples of all sheet material, base, edge, strips, feature strips, etc., required for this project, for approval by Departmental Representative.
- .2 Deliver packaged materials in original unopened containers.
- .3 Keep delivered material dry and free from stains. Store cementitious material off damp surfaces.
- .4 Store roll goods vertically, protect edges from damage.
- .5 It shall be the flooring suppliers and installers responsibility to advise the contractor how long the building and substrates must be cured and up to temperature in order that the flooring material will not be subject to temperature changes, and moisture.
- .6 Store flooring materials in each area of application and to allow material to reach equal temperature with area.
- .7 Work to be done by experienced tradesmen..

1.4 MAINTENANCE AND EXTRA MATERIALS

- .1 Leave larger usable pieces of each colour and pattern of flooring material required for this project for maintenance staff's later use. Approximately 2%.
- .2 Store where directed.
- .3 Provide Department Representative with maintenance instructions as per Supplementary General Conditions.

1.5 GUARANTEE

- .1 This contractor shall guarantee his work as to labour, materials and workmanship for a period of one year after the date of the Departmental Representative's Certificate of Substantial Completion plus provide a written manufacturer's five (5) year Warranty for material.

1.6 SEAMING PLAN

- .1 Contractor shall provide for Departmental Representatives approval, and prior to commencement of flooring installation, plan of all areas to receive resilient flooring showing location of all seams. Flooring shall be installed in accordance with approved seaming plan.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Sheet Resilient - 2.5 mm thick x 1830 mm wide, design elements shall extend throughout the thickness of the product and it shall be dense enough to withstand loads of 8.78 kg/cm². Allow for two (2) colours to be selected by the Departmental Representative from the standard range. Refer to drawings for accent flooring patterns and locations. Product series to be specified by Departmental Representative from those listed below:
 - .1 Forbo "Marmoleum" Sheet Flooring with ETC finish Real, Piano, and MCS Series
 - .2 Armstrong Linoleum Sheet Flooring with NATURcoat Linorette, Colorette, Uni Walton, and Granette, Series
 - .3 Johnsonite Linoleum Sheet Flooring Harmonium xf2 Series
- .2 Rubber Flooring
 - .1 Size: 38" x 38" or approved alternate size.
 - .2 Edge: Square cut.
 - .3 Thickness: 3/8"
 - .4 Attachment: Adhered to substrate.
 - .5 Product series to be specified by Departmental Representative from those listed below:
 1. Dinoflex; Product: Sport Mat, Standard Collection, 50% Colour Fleck.
 2. Regupol; Product: AKTIV, Tone Series, 50% Colour Fleck.
 3. Connor Sports; Product: [ElastiMat](#), [Standard Colour](#), 50% Colour Fleck.

- .3 Reducer Strips - resilient to concrete, 2.5 mm wide, tapered rubber.
Carpet to resilient, 45 mm wide, tapered rubber.
- .4 Resilient Base - rubber top set, non-coved, 3 mm by 150 mm as per drawings. Colour to be selected by Departmental Representative from manufacturers "premium" colour range.
- .5 Cove Fillers Strips - for flashcove shall be manufactured from a homogeneous composition of polyvinyl chloride (PVC), high quality fillers, and colorants, shall meet or exceed ASTM E 648 Class 1 Flammability requirements. 31.8 mm (1-1/4") radius filler strip for coved sheet goods, 22.2mm (7/8") long wall and floor mounting surface.
- .6 Stainless steel Cove Caps - for flash cove and at open ends of resilient floor.
- .7 Primers and Adhesives - type to be acceptable to resilient flooring manufacturer for specific material on applicable substrate concrete (suspended slab); Adhesive for rubber base shall be Contact Cement, applied in accordance with manufacturer's recommendations.
- .8 Cleaner - Type recommended by resilient flooring material manufacturer for material type and location.
- .9 Sub-floor Cleaner – Type to be acceptable to resilient flooring manufacturer.
- .10 Sub-floor filler – premium high-flow self-leveling concrete underlayment patch. Portland cement based, microfiber reinforced, fast setting.

PART 3 EXECUTION

3.1 INSPECTION & GENERAL

- .1 Provide a seaming plan for approval. Seams to run parallel to major traffic, to produce minimum number of seams and to produce symmetrical pattern. Corners of borders shall be 45 degrees unless full tile fit.
- .2 Inspect subfloor surfaces on which this work depends. Report unsatisfactory conditions to the Departmental Representative. Commencement of work of this section will constitute acceptance of substrate condition.
- .3 Ensure floor surfaces are smooth and flat to plus or minus 3 mm over 3000 mm.

- .4 Ensure concrete floors are dry, maximum 7% moisture content and exhibit negative alkalinity, carbonization or dusting. Test for moisture by floor manufacturer's recommended method.

3.2 LEVELLING

- .1 Fill low spots, cracks, joints, holes and other defects with sub-floor filler. Grind down high spots.
- .2 Clean floor and apply trowel and float filler to leave smooth, flat, hard surface. Prohibit traffic until filler cured.

3.3 INSTALLATION – FLOORING (General)

- .1 Thoroughly clean substrate prior to installation.
- .2 Prime concrete sub-floors to receive resilient flooring as recommended by manufacturer. Prime areas to dry thoroughly prior to application of adhesives.
- .3 Spread cement evenly in quantity and with tools recommended by manufacturer. Do not spread more adhesive than can be covered by flooring before initial set takes place.
- .4 Lay sheet flooring with joints and seams parallel to building lines to produce symmetrical pattern and minimum number of seams and to patterns established on drawings.
- .5 Install sheet flooring with maximum sheet widths and with sheet parallel to length of room.
- .6 Double cut sheet joints and install according to manufacturer's recommended procedure.
- .7 Make joints and terminate resilient flooring at centerline of door in door openings where adjacent floor finish is dissimilar.
- .8 Continue flooring throughout areas and under all casework without interrupting floor pattern. Flooring to be installed before unit casework unless shown otherwise.
- .9 Scribe flooring to walls, columns, floor outlets and other appurtenances to produce tight joints.
- .10 Set flooring in place, press with 45 kg. minimum roller to ensure full adhesion.
- .11 Install with joints tight, flush and true.

- .12 Install rubber reducing strips at unprotected or exposed edges where resilient flooring terminates or differences of thickness occurs between concrete, glued down carpets, resilient floors, and quarry tile.
- .13 Finished floor to be smooth and free of buckles, cracks, breaks, bubbles, bumps caused by dirt under, waves and projecting edges.
- .14 Seal flooring around floor drains with silicone sealant.
- .15 Seal perimeter of floors in wet areas, washrooms, janitor rooms, mechanical rooms and similar areas with rubber base with silicone prior to installation of baseboard.
- .16 Weld seam of sheet flooring in strict accordance with manufacturer's written instructions.

3.4 INSTALLATION – FLOORING (Base)

- .1 Fit joints tight square and vertical.
- .2 Mitre internal corners.
- .3 Install base on solid backing. Adhere tightly to wall, millwork and floor surfaces using specified adhesive. Bottom cove shall be tight to floor to prevent "kick-in".
- .4 Scribe and fit to door frames and other components.
- .5 Install straight and level to variation of plus or minus 3 mm over 3000 mm straight edge.
- .6 Base shall be installed in maximum lengths with joints at inside corners.
- .7 At outside corners notch the backside of base before wrapping around corner.
- .8 Cut exposed ends of base shall have bottom corner rounded.

3.5 CLEANING

- .1 Remove excess adhesive from floor, base and wall surfaces without damage.
- .2 Protect traffic areas over new floors with 6 mil. polyethylene, cardboard or similar approved cover after initial cleaning.
- .3 Prohibit traffic from floor finish for 48 hours after installation.

PART 1 GENERAL

1.1 SCOPE OF WORK

- .1 The work of this section includes the supply and installation of seamless epoxy flooring system utilizing multi-coloured granular aggregate with ceramic-like finish.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- .1 Cast-in-Place Concrete Section 03 30 00
.2 Reinforced Unit Masonry Section 04 26 19

1.3 REFERENCES

- .1 Current editions of the following:
- .1 ASTM C 413 Test Method for Absorption of Chemical Resistant Mortars, Grouts and Monolithic Surfaces
 - .2 ASTM C 531 Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts and Monolithic Surfaces
 - .3 ASTM C 579 Test Method for Compressive Strength of Chemical Resistant Mortars, Grouts and Monolithic Surfaces
 - .4 ASTM D 580 Test Method for Flexural Strength and Modulus of Elasticity of Chemical Resistant Mortars, Grouts and Monolithic Surfaces
 - .5 ASTM D 638 Test Method for Tensile Properties of Plastics
 - .6 ASTM D 1864 Test Method for Moisture in Mineral Aggregates
 - .7 ASTM D 2240 Test Method for Rubber Property - Durometer Hardness
 - .8 ASTM D 4060 Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser
 - .9 ASTM D 4263 Test Method for Capillary Moisture in Concrete by Plastic Sheet
 - .10 ASTM D 4258 Standard Practice for Surface Cleaning Concrete for Coating
 - .11 ASTM D 4259 Standard Practice for Abrading Concrete
 - .12 ASTM D 4260 Standard Practice for Acid Etching Concrete
 - .13 ASTM D 4262 Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.

1.4 SUBMITTALS

- .1 Submit manufacturer's technical data and product literature indicating that the products comply with specified requirements.
- .2 Submit two mock-up sample coupons that are representative of the finished floor surface, texture and color.

1.5 ENVIRONMENTAL CRITERIA

- .1 Green Alternatives: Where available and to the extent that product performance is not adversely affected, trades and suppliers shall provide data on the "green" performance of products, and/or suggest sustainable products for the consideration of the Departmental Representative, such as those with recycled content and low VOC. In all cases the contractor shall obtain written approval from the tendering authority prior to bidding an alternative product.

1.6 QUALITY ASSURANCE

- .1 Installer Qualification: Use only a qualified installer for the flooring preparation of substrate, possible delaminated areas, crack and joint repair and complete flooring installation.
- .2 Mock-up: On site, fabricate a panel approximately 10 sq. m. (100 sq. ft) to demonstrate quality of finished floor system, complying with manufacturer's instructions. Install panel where directed by Departmental Representative. Maintain panel as a standard of quality for all installations. Departmental Representative to review and approve install in one small room prior to proceeding with the remainder of installation.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver product in factory packages, clearly marked with manufacturer's identification, printed instructions, lot numbers and shelf life expiration date for each component.
- .2 Store materials at 16 degree C to 30 degree C in dry environment away from sunlight, excessive heat or other hazards. Keep from freezing.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

- .1 Sika available from Sika Canada Inc.
- .2 Stonhard available from StonCor Group. (Traffic bearing surface, room 201 only) Confirm with Departmental Representative prior to purchase and installation.

2.2 SYSTEM DESCRIPTION

- .1 Nominal 5mm (3/16") thick seamless waterproof flooring system with decorative chemical- and slip-resistant surface comprised of the following:
 - .1 Base - three-component trowelled mortar base consisting of epoxy resin, curing agent and finely graded silica aggregate. Applied over compatible waterproofing membrane system.
 - .2 Undercoat - three component, free-flowing epoxy formulation consisting of resin, curing agent and fine aggregate.
 - .3 Aggregate - brightly coloured quartz broadcast aggregate.
 - .4 Sealer - two component high performance UV resistant clear epoxy sealer.
 - .5 Coved Base - 150mm (6") high coved base to provide integral seal at the joint between floor and wall.

2.3 MATERIALS

- .1 Flooring System Approved Products: for all rooms requiring "resinous epoxy flooring" in finish schedule, except room 201
 - .1 "Sikagard Duroplast 100", two part, high gloss, high solids, low VOC, abrasion resistant, antimicrobial epoxy floor coating. Not suitable for traffic bearing surfaces. No Substitutions.
- .2 Flooring System Approved Products: for room 201 only
 - .1 "Stonshield SLT" with "Stonproof ME7" waterproof membrane system. Confirm with Departmental Representative prior to purchase and installation.
- .3 Colour: to be selected by Departmental Representative from manufacturer's full range.

2.4 FLOOR SYSTEM PERFORMANCE REQUIREMENTS

- .1 The flooring, when cured, shall provide the following typical properties:

<u>Property</u>	<u>Test Method</u>	<u>Result</u>
Water Absorption	ASTM D 570	0.62% (24h immersion)
Tensile Strength	ASTM D 638 Type IV	2975 psi (20.5 MPa)
Abrasion Resistance	ASTM D 4060 (CS-17)	80 mg loss

Flamespread	CAN/ULC S-120	6
Impact Resistance	ASTM D3029	Micro cracks at 1.31 J (11.6lb-in) Visible cracks at 2.2 J (19.3lb-in)
Moisture Vapour Permeability	ASTM E 96	0.11 perms (with fiberglass) 0.89 perms (without fiberglass)

PART 3 EXECUTION

3.1 INSPECTION

- .1 Before starting work, ensure that environmental and site conditions are suitable for application and curing of flooring.
- .2 Inspect surfaces for acceptability of levelness, moisture content, pitch to drains and other critical factors.
- .3 Report in writing to Departmental Representative any deficiencies that could impair work. Surfaces must be approved prior to application of flooring.

3.2 SURFACE PREPARATION

- .1 Prepare surfaces in accordance with manufacturer's instructions.
- .2 Remove concrete laitance by sandblasting, grit blasting, or other method approved by manufacturer.
- .3 Surface must be clean, free from all wax, grease, oils, fats, soil, loose or foreign materials, and generally sound and dry prior to application.
- .4 For proper adhesion prepare surface to show open pores throughout, and to have sandpaper texture.

3.3 PROJECT CONDITIONS

- .1 Concrete surface temperature shall be between 16°C and 30° for a minimum of 48 hours before, during and after installation, or until flooring is cured.
- .2 Substrates in contact with ground must have a properly installed, effective vapour barrier to prevent hydrostatic, capillary or moisture vapour pressure. Concrete must contain less than 3% moisture when tested per ASTM D 1864.
- .3 Concrete shall be designed and installed to minimize random cracking, curling, slab deflections and shall contain well designed control and isolation joints.

- .4 Concrete shall be moisture cured and sealers or membrane curing agents shall not be used.
- .5 There shall be proper ventilation, lighting and clean, drinkable water supply.
- .6 Flooring shall be installed prior to fixtures and fittings.
- .7 Floors shall be kept free of traffic and no other trades shall be permitted in rooms during the application and curing of the coating.
- .8 Protect adjacent surfaces from damage resulting from work of this trade. If necessary, mask and/or cover adjacent surfaces, fixtures, equipment, etc. by suitable means.

3.4 MIXING

- .1 Comply with manufacturer's instructions for mixing procedures.
 - .1 Pre-mix each component before every batch to ensure uniformity.
 - .2 Carefully measure and mix the components together.
 - .3 Carefully pre-mix quartz aggregate to match desired colour pattern.

3.5 INSTALLATION

- .1 Follow manufacturer's written instructions.
- .2 Apply elastomeric membrane over cracks in substrate.
- .3 Install cove base in accordance with manufacturer's instructions.
- .4 Prime entire surface with recommended primer.
- .5 Apply epoxy and aggregate matrix in accordance with manufacturer's instruction to a total thickness of 3.2 mm (1/8 inch). Trowel slurry coat in place. Broadcast pre-mixed grains to saturation.
- .6 Apply grout coats and topcoats at manufacturer's recommended coverage to provide uniform, dense surface.
- .7 Allow proper cure time for each installation step.
- .8 Allow the finished epoxy flooring to cure for a minimum of 7 days from completion before putting into service.

Part 1 General

1.1 SECTION INCLUDES

- .1 Carpet tile.
- .2 Accessories.

1.2 RELATED SECTIONS

- .1 Section 03 30 00 - Cast-in-Place Concrete: Stair substrate surface.
- .2 Section 09 65 10 - Resilient Flooring: Base finish.

1.3 REFERENCES

- .1 CAN/CGSB-4.129-93 (R1997) - Carpets for Commercial Use.
- .2 CAN/ULC-S102-10 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .3 CAN/ULC-S102.2-10 - Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings and Miscellaneous Materials and Assemblies.
- .4 CRI Carpet Installation Standard - 2011

1.4 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colours available and method of installation.

1.5 CLOSEOUT SUBMITTALS

- .1 Section 01 78 10: Submission procedures.
- .2 Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Section 01 78 40: Maintenance and extra material requirements.
- .2 Extra Stock Materials: Provide 5% carpet tiles of each colour and pattern selected.

1.7 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

- .2 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Section 01 35 26: Environmental conditions affecting products on site.
- .2 Store materials for three (3) days prior to installation in area of installation, to achieve temperature stability.
- .3 Maintain minimum 21 degrees C ambient temperature three days prior to, during and 24 hours after installation materials.

Part 2 Products

2.1 MANUFACTURERS

- .1 Milliken; Product: Paste Up- Public Reaction.
- .2 Other acceptable manufacturers offering functionally and aesthetically equivalent products.
 - .1 Interface; Product: Starting Point.
 - .2 Mohawk Group; Product: Emerging Lights.

2.2 CARPET TILE

- .1 Carpet Tile: manufactured in one colour dye lot.
 - .1 Tile Size: Nominal 500 x 500 mm.
 - .2 Thickness: Nominal 10 mm.
 - .3 Colour: as selected, allow for three (3).
 - .4 Pattern: as selected, allow for three (3).

2.3 ACCESSORIES

- .1 Sub-Floor Filler: white premix latex; type recommended by carpet manufacturer.
- .2 Primers and Adhesives: releasable type and recommended by carpet manufacturer.
- .3 Edge Strips: vinyl type, matt finish, colour from standard range. Product Standard: Johnsonite CTA-XX-A.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Verify that surfaces are smooth and flat with maximum variation of 6 mm in 3 m, and are ready to receive work.

- .3 Verify concrete floors are dry to a maximum moisture content of 7 percent; and exhibit negative alkalinity, carbonization, or dusting.

3.2 PREPARATION

- .1 Prepare floor to CRI-104.
- .2 Remove subfloor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with subfloor filler.
- .3 Apply, trowel, and float filler to achieve smooth, flat, hard surface. Prohibit traffic until filler is cured.
- .4 Vacuum clean substrate.

3.3 INSTALLATION

- .1 Install carpet tile, accessories and adhesive to manufacturer instructions and CRI-104.
- .2 Install carpet tile accessories and adhesive in accordance with manufacturer's written instructions.
- .3 Integrate and blend carpet from different cartons to ensure minimal variation in colour match.
- .4 Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- .5 Lay carpet tile to consistent pattern, tile direction quarter turn to next unit, set parallel to building lines.
- .6 Locate change of colour or pattern between rooms under door centerline.
- .7 Place carpet tile dry over substrate.

3.4 CLEANING

- .1 Section 01 74 00: Cleaning installed work.
- .2 Remove excess adhesive without damage, from floor, base, and wall surfaces.
- .3 Clean and vacuum carpet surfaces.

3.5 PROTECTION OF FINISHED WORK

- .1 Section 01 78 40: Protecting installed work.
- .2 Do not permit traffic over unprotected floor surface.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

- .1 The work of this section comprises the furnishing of all labour, materials and equipment required for the supply and installation of all acoustic wall fabric panels as shown on the drawings and herein specified.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- .1 Reinforced Unit Masonry Section 04 26 19
- .2 Rough Carpentry Section 06 10 00
- .3 Painting Section 09 91 10

1.3 REFERENCE STANDARDS

- .1 The acoustic wall panel system shall have a Fire Hazard Classification of 0 - 25 when tested in accordance with ASTM E84.
- .2 Submit a test report from an accredited acoustical testing laboratory that demonstrates the specified NRC performance values. The tests are to be conducted according to ASTM 0423-90a using a Type A mounting as specified in ASTM E795-93.

All fabric finishes specified for acoustic panels shall be tested in accordance with ASTM D6207 - Standard Test Method for Dimensional Stability of Fabrics to Changes in Humidity and Temperature.

1.4 SUBMITTALS

- .1 Submit to the Departmental Representative of record, three (3) complete sets of CAD generated shop drawings, or standard detail sheets, prepared by the manufacturer showing all necessary details and dimension requirements which will subsequently be field verified and revised as required by the Departmental Representative.
- .2 Samples: Submit (3 sets) manufacturers standard 8" (200mm) x 11" (280mm) sample panels of each type of product as specified in Part 2 to the Departmental Representative for approval. Product shall be original production material in fabric finish specified for final use. Departmental Representative to specify colour from the full range.
- .3 Certification: Submit to the Department Representative a certificate of compliance to specified acoustical and fire performance criteria as stated section 1.2 and Part 2 of this specification, signed by an officer of the panel manufacturer and attach independent laboratory test results for each product used, showing that the products supplied as components and complete assemblies, meet or exceed the specified requirements.

1.5 GUARANTEE

- .1 This Contractor shall guarantee his work as to labour and material for a period of one year after the date of Substantial Completion.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver fabricated units and related components to the site for installation in accordance with a reasonable schedule furnished by the contractor. On-site storage shall be such as to assure that all panels and associated materials are protected from damage, and storage area is climatically controlled to normal operational levels.
- .2 Prior to panel installation, the site must be free of all wet and dusty trades and the climatic conditions stabilized to normal operational levels. Panels shall be allowed to stabilize on site 24 hours prior to installation.
- .3 Panels must only be handled by persons wearing clean light-weight gloves. It is very important that personnel installing hardware (wall clips, screws, anchors, etc.) do not handle the panels before putting the clean lightweight gloves on.
- .4 Store all materials off the ground and protected from dust and dirt of construction operations.

Handle materials in a manner that will protect them from damage and with safety.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Furnish and deliver prefabricated fabric finished acoustic wall panels as described in this section for installation in areas as shown on drawings meeting or exceeding the following requirements:
- .2 High Impact Resilient Panels shall be High Impact Resistant type with chemically hardened edges, The panel shall be constructed of 6 to 7 lb./cu.ft (96 to 112 kg/cu.m.) density acoustically absorptive core, face laminated with a 16 - 20 lb/cu.ft. (256 - 320 kg/cu.m.) high density acoustically transparent layer, 1" (25 mm), overall thickness, and finished as detailed in this section. The core shall be free of surface defects and sanded as required to a uniform thickness, which will not vary by more than +/- 0.03" (1.0 mm). The panels shall be fabricated to sizes supplied by the installing Contractor, using a CAD/CAM (CIM) Robotics cutting system to ensure accurate panel core dimensions to a tolerance of +/- 0.06" (1.6mm). Edges shall be chemically hardened to withstand moderate impact during installation and ongoing maintenance. Chemically hardened edges will be profiled as shown on the architectural drawings. Soft or non-framed edge treatments are not acceptable. All panels shall be clearly text marked with the

project I.D. number, panel number, location code, quantity of units per size, and correspond to the shop drawings or bill of materials.

- .3 Finish shall be: 100% polyester fabric, chosen from the manufacturers full range of colours (not white). Fabric finishes shall be stretch-applied over the panel face, bonded to the panel edges and returned a minimum of one inch (25mm) on the back of the panel. The finish shall be flat and wrinkle free and fully tailored at corners with no exposed darting. All finishes shall be tested for suitability (ASTM D6207) and approved for use by the panel manufacturer prior to procurement and fabrication.
- .4 Mounting shall be Installation shall be by use of slide and engage clips ("Z" clips), either into a anti-rattle wall clip, or into continuous wall track. Panel clips and wall clips (or continuous wall track) shall be a minimum 20 gauge satin-coat steel with wall clips mechanically mounted to the back of the panels. All fasteners (wall anchors, screws, etc.) are to be supplied by the installing contractor.
- .5 Installation shall be in accordance with local code requirements, manufacturers' instructions, and as shown on approved shop drawings, or detail sheets. Installer shall provide for shimming and adjustments as required to maintain consistent alignment of joints and of finished panel faces, and to ensure unstressed clip/mounting locations.
- .6 Acoustic Performance: Panels shall have noise reduction coefficient values of the following when tested in accordance with section 1.2 of this specification.

	Frequency (Hz)							
	125	250	500	1000	2000	4000	NRC	SAA
1" thickness	0.03	0.37	0.89	0.94	1.10	1.09	0.85	0.87

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

- .1 Examine the condition of the substrate and the conditions under which the work of this Section is to be performed. Notify the Contractor in writing of any conditions. Do not proceed with the work until satisfactory conditions have been corrected in a manner satisfactory to the installer.
- .2 Do not install acoustic wall panel fabric in any space until:
- .1 The space has been enclosed and is weathertight.
 - .2 All wet work has been completed and is dry.
 - .3 Painting is completed and wall base and floor covering are installed.
 - .4 All adjacent and related work of other trades has been completed including, in part, Architectural Woodwork, Masonry, Doors and Frames,

Hardware, Gypsum Drywall, Plastering, Wall Covering, Painting, Ceiling Grid and Electrical Work.

- .5 Ambient temperature and humidity are continuously maintained at values indicated for final acceptance of the building or occupancy of the space.

3.2 INSTALLATION

- .1 Field measure each wall area which is to receive the acoustical treatment to establish the exact layout of the units as shown on elevations.
- .2 Apply the framework of locking channels at the perimeter of the wall or area to receive the acoustical wall fabric panel treatment, as shown on the drawings.
- .3 Secure the framework with suitable mastic and special, heavy duty, one inch diverging staples located not more than 2 inches or greater.
- .4 Other fasteners may be required for specific substrates, providing they are in strict accordance with the manufacturer's printed instructions and comply with governing regulations and fire resistance rating requirements specified.
- .5 Install or shim electrical outlets so they fit flush to finished surface.
- .6 Install the framework plumb and straight, flush in proper alignment.
- .7 Install the sub-surface material, continuous and flush, to the shoulder of the track and so they do not telegraph through fabric covering.
- .8 Cut the fabric from each roll maintaining sequence of drops and matching direction of weave for sequential and uniform installation.
- .9 Install fabric into locking jaws of the track framework. The fabric shall be stretched tightly and smoothly and be free of defects and flaws. The fabric grain shall be plumb and aligned vertically and horizontally.

3.3 CLEANING AND PROTECTION

- .1 Clean exposed surfaces of acoustical wall panels. Trim and remove all loose threads.
- .2 Remove surplus materials, rubbish and debris resulting from the installation and leave areas of installation in a neat, clean condition.
- .3 If site conditions require, cover fabric panels with vinyl drop cloth.

3.4 ADDITIONAL MATERIAL

- .1 Provide to the Department Representative on completion of work, maintenance stock of fabric finish(es) used in an identical dye lot, the greater of an amount equal to 2% of the total yardage required or enough material to cover one of the largest acoustical units supplied.

PART 1 GENERAL

1.1 SCOPE OF WORK

- .1 The work of this section includes the furnishing of all labour, materials and equipment required to paint all surfaces indicated on drawings and herein specified.
- .2 Generally all items to be painted unless factory finishes or specified elsewhere. Be familiar with building components that are prime coated or factory finished as specified elsewhere.
- .3 Be familiar with new building components that are prime coated or factory finished as specified elsewhere.
- .4 Related work specified elsewhere:
 - .1 Concrete Section 03 30 00
 - .2 Reinforced Unit Masonry Section 04 26 19
 - .3 Metal Fabrications Section 05 50 00
 - .4 Carpentry (Tectum Board) Section 06 10 00
 - .5 Architectural Cabinetwork Section 06 41 11
 - .6 Gypsum Board Section 09 29 00
 - .7 Painting for Mechanical Mechanical
 - .8 Painting of Electrical items Electrical.

1.2 COLOUR SCHEDULE/SAMPLES

- .1 Immediately upon receipt of contract provide name and/or colour swatches of Paint Manufacturer proposed to be used. Prior to commencement of work, the Departmental Representative will furnish a colour schedule; where and what colours and finishes are to be applied. Colour schedule does not take precedence over this specification.
- .2 The Departmental Representative reserves the right to have sample patches of colours and finishes applied in place and approved before commencement of painting.

1.3 ENVIRONMENTAL CRITERIA

- .1 This building is designed in accordance with sustainable building practices; trades and suppliers are encouraged to suggest sustainable products as alternatives to those specified for the consideration of the Departmental

Representative. In all cases the contractor shall obtain written approval from the tendering authority prior to bidding an alternative product.

- .2 Submittals: Submit a complete list of paint materials proposed for use, together with manufacturer's technical information, including paint label and analysis, VOC content, and Material Safety Data Sheets (MSDS).
- .3 Materials Maximum VOC Levels (Applies to Interior painting only)
 - .1 Waterborne Latex (Acrylic) Emulsion Paint:
 - .1 Low VOC paint: flat and eggshell, VOC content less than 50 grams / liter.
 - .2 Low VOC paint: semi-gloss and gloss, VOC content less than 150 grams / liter.
 - .2 Oil-Based Paint: Not Applicable.
 - .3 Epoxy: Waterborne epoxy; maximum VOC content: 200 grams / liter.
 - .4 Transparent Finishes
 - .1 Polyurethane, water-based: maximum VOC content: 350 grams / liter.

1.4 **QUALITY CONTROL/WORKMANSHIP**

- .1 The Contractor shall arrange for implementation of the local MPI Accredited Quality Assurance Association's two (2) year guarantee in accordance with the MPI Painting Manual requirements for painting, paid for by the Department Representative, and commencing on the date of Departmental Representative's Certificate of Substantial Completion.
- .2 Only qualified journeymen who have a "Tradesman Qualification Certificate of Proficiency" shall be engaged in painting and decorating work. Apprentices may be employed provided they work under the direct supervision of a qualified journeyman in accordance with trade regulations.
- .3 Standard for products to be used on this project are listed in MPI manual.
- .4 Deliver paint materials in sealed original labelled containers, bearing manufacturer's name, type of paint, brand name, colour designation and instructions for mixing and/or reducing.
- .5 Thinning shall only be done in strict accordance with manufacturer's directions, and dilution or misuse will not be allowed.
- .6 Store paint materials at a minimum ambient temperature of 10 deg. C in a well ventilated and heated area.
- .7 Generally products for each specific job shall be from one manufacturer.
- .8 All work shall be performed to the quality standards set out in the Master Painters and Decorators Association of B.C. Manual (MPI).

1.5 ENVIRONMENTAL CONDITIONS

- .1 Humidity: moisture content of the surfaces shall conform to the following. Tests shall be by an electronic "Moisture Meter" when required by the Departmental Representative.
 - .1 Gypsum Board - maximum moisture content 12%.
 - .2 Masonry - Concrete, Concrete Block - maximum moisture content 12% for solvent type paint. Masonry surfaces shall be tested for alkalinity. Masonry units must be installed at least 28 days prior to painting and be visually dry on both sides before painting commences.
 - .3 Wood - maximum moisture content 12%.
- .2 Temperatures - no painting shall be performed when temperatures on the surfaces or in the air in the vicinity of the painting work are below 5 deg. C. The minimum temperature allowed for Latex paints shall be 10 deg. C interior work and 5 deg. C exterior work unless otherwise approved.
- .3 Ventilation/Heating - Ensure there is adequate continuous ventilation and sufficient heating facilities to maintain temperatures above 10 deg. C for 24 hours before, during and after paint application. Do not paint on surfaces where condensation has or is likely to form.

1.6 PROTECTION

- .1 Protect other surfaces from paint and damage, or make good.
- .2 Furnish sufficient drop cloths, shielding and protective equipment to prevent spray or droppings from fouling surfaces not being painted.
- .3 Place cotton waste, cloths and material which may constitute a fire hazard in metal containers and remove daily from site.
- .4 Remove all electrical plates, surface hardware, fittings and fastenings, prior to painting operations. These items shall be stored, and replaced on completion of work in each area.
- .5 Do not use a cleaning solvent that may remove the permanent lacquer finish on hardware items.
- .6 **DO NOT PAINT OVER FIRE RATING (ULC) LABELS.**

1.7 MAINTENANCE MATERIALS

- .1 Turn over to Department Representative a quantity of all colours scheduled for future touching up. In the case of major colours, four (4) litres. For minor colours, one (1) litre.
- .2 Containers shall be tightly sealed and clearly labelled for identification.
- .3 This requirement shall be met before substantial completion is granted.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 All products specified herein shall be in accordance with the **MPI** Architectural Painting Specification Manual (latest edition) "Approved Product" listing.
- .2 Paint products shall meet the requirements of the Environmental Choice Program, Department of the Environment, where available for each specified system. Water-based paint to be certified to ECP-07-89, solvent based paints to ECP-12-89. Cloverdale Paints and General Paints are approved paint suppliers.
- .3 Products to comply to CGSB Standards.
- .4 Solvents to be odour-free type.
- .5 Paints shall be ready-mixed except for field-catalyzed types.
- .6 Where required, paints and coatings shall meet flame spread and smoke developed ratings designated by National Building Code of Canada 2010 and/or authorities having jurisdiction.

PART 3 EXECUTION

3.1 CONDITIONS OF SURFACES

- .1 Prior to commencement of work, thoroughly examine all surfaces scheduled to be painted.
- .2 Report in writing to the Departmental Representative, any condition adversely affecting this work. Commencement of work shall be held to imply acceptance of surfaces.
- .3 Ensure all subsequent coats are compatible with primers and shop coats.

3.2 PREPARATION OF SURFACES

- .1 Lightly sand as required and thoroughly vacuum clean all surfaces to be painted. Assume full responsibility for the proper preparation of such surfaces to receive the paint materials specified. Specifically prepare various surfaces as follows:
 - .1 Mildew and moss removal: scrub with solution of T.S.P. and bleach, rinse with clear water and allow surface to dry completely.
 - .2 Aluminum: (excluding anodized aluminum.) Remove surface contamination by steam, high pressure water or solvent washing. Apply etching type primer, then paint immediately.

- .3 Canvas and Cotton Insulated Coverings: Remove dirt, grease and oil. Moisture content to be 12% or less.
 - .4 Concrete Floors: remove contamination, acid etch and rinse with clear water and assure acid-alkali balance, let dry.
 - .5 Copper: remove surface contamination by steam, high pressure water or solvent washing. Apply etching type primer or acid etching, then paint immediately.
 - .6 Gypsum Wallboard: remove contamination, prime surface to show defects, have defects repaired by others prior to applying subsequent coats.
 - .7 Galvanized (Zinc Coated) Iron: remove surface contamination, wash metal with solvent and apply coat of an etching type primer. If manufacturer has given metal a pre-treatment refer to them for preparation and painting instructions. Pre-treatment is not a primer.
 - .8 Concrete and Masonry surfaces: (concrete, concrete block, stucco, cement render, etc.): remove dirt, loose mortar, scale, powder and other foreign matter. Remove oil and laitence by solution containing T.S.P., then rinse and let dry. Concrete stains caused by weathering of corroding metals shall be removed with solution of sodium metasilicate after being thoroughly wetted with water. Let dry.
 - .9 Steel and iron (shop primed): clean surfaces of grease, rust, scale, dirt and dust. Where steel and iron have a heavy coating of scale, remove by wire brushing or sandblasting. Exposed steel to be sanded smooth as required.
 - .10 Steel (unprimed): prepare to CGSB 85-GP-16 paragraph 3 and as .8 above.
 - .11 Wood, plywood and millwork: Wipe off dust and grit prior to prime coat; seal knots, pitch streaks and sappy sections. Fill all nail holes and fine cracks after primer has dried and sand between coats. Backprime interior and exterior woodwork.
- .2 Prepare all surfaces not included in 3.2.1 above in accordance with the MPI Painting Specification Manual requirements.

3.3 APPLICATION

- .1 Painting coats specified are intended to cover surfaces satisfactorily with an even colour tone.
- .2 Each coat of finish shall be dry and hard before the next coat is applied, unless the manufacturer's directions state otherwise.
- .3 Tint fillers to match wood when clear finishes are specified; work filler well into the grain and before it has set, wipe the excess from the surface.

- .4 Exterior and interior woodwork to be stained and/or varnished shall be back-primed with gloss varnish reduced 25% with mineral spirits or equivalent. Woodwork to receive stain finish shall be backprimed with same material.
- .5 Prime top and bottom edges of wood doors with enamel undercoat when the doors are to be painted and primed with gloss varnish when doors are to receive a stained or clear finish. (Varnish on wood doors shall be applied after stain coat.).

3.4 MECHANICAL AND ELECTRICAL EQUIPMENT

- .1 The Painting Trade shall do all painting, identification and labeling to colours and finishes indicated in Mechanical Trade Divisions. Identification and labeling by use of applied tapes and similar devices shall be by the Mechanical trade.
- .2 Paint all mechanical and electrical cabinets, grilles, piping and conduit systems, ductwork, etc. where exposed to view in finished areas the colour of the adjacent surface unless scheduled otherwise. Galvanized duct work in mechanical rooms need not be painted.
- .3 Finish uninsulated pipe lines with one coat of zinc chromate primer and two coats of machinery enamel brushed to a thin even finish. Use two component Etch Bond for aluminum or galvanized surfaces. Use one coat of Chromotox Primer for delayed top coat application. Apply one coat of Satin Glo Latex Printer Sealer to insulated piping, tanks and exposed areas. High heat aluminum paint to be used on lines where necessary.
- .4 Paint inside of ductwork only where visible through open grilles, with primer and one coat of dull black paint.
- .5 Paint interior and exterior grilles, hoods, fans, and piping not factory finished, as specified.

3.5 SCHEDULES

- .1 Generally colours will be selected from manufacturer's standard lines.
- .2 Generally exterior miscellaneous metals, door frames and flashings will each be one colour or to match adjacent finishes.
- .3 Generally, interior steel door frames, miscellaneous metals and similar trim each shall be one colour or to match adjacent surfaces.
- .4 Hardwood doors, MDF panelling and trims, and wood trims shall receive clear finish.
- .5 The following titles and code numbers refer to the C.P.C.A. Architectural Painting Specification Manual, for type of coating, grade, named products and their manufacturers.

- .1 Exterior Low Contact Galvanized Metals - Including galvanized flashings, exposed deck, ductwork, hoods, fans, access hatches, etc. unless prepainted.
 - .1 EXT 5.3A Latex, Semi-Gloss Finish, Premium Grade.
1st coat - Cementitious primer.
2nd coat - Latex.
3rd coat - Latex.

- .2 Exterior Galvanized Metals - High Contact - including doors, frames, bollards, hand rails, guard railings, etc.
 - .1 EXT. 5.3D - Polyurethane Pigmented; Premium Grade; G3 "Eggshell" finish
1st coat - Vinyl Wash Primer
2nd coat - Epoxy
3rd coat - Polyurethane
4th coat - Polyurethane

- .3 Concrete Floors – Service Area's
 - .1 INT 3.2A Latex Floor Enamel (Epoxyshield Basement)
1st coat – Heavy Duty Degreaser
2nd coat -- Latex Floor Enamel
3rd coat – Latex Floor Enamel
4th coat – Latex Floor Enamel

- .4 Concrete Floors – 200 Series Rooms (non-slip)
 - .1 INT 3.2C Epoxy Floor Paint (Duroplast 100)
1st coat – Epoxy Floor Paint (thinned to a max. of 5% by volume)
2nd coat – Epoxy Floor Paint
3rd coat – Epoxy Floor Paint

- .5 Interior Concrete Masonry - General
 - .1 INT 4.2A Latex Premium Grade, Gloss Level 3
1st Coat - Latex Block Filler
2nd Coat - Latex

- .6 Interior Concrete Unit Masonry – 200 Series Rooms
 - .1 INT 4.2R Epoxy High Build - Low Gloss (Duroplast 150)
1st Coat - Epoxy Block Filler
2nd Coat - Epoxy High Build (low gloss)
3rd Coat - Epoxy High Build (low gloss)

- .7 Miscellaneous Metal, Steel Deck and Exposed Structural Members not subject to high contact - including steel cabinets; control panels,

convectors, registers, pipes, steel joists, etc. that are not already factory finished to the final colour scheme.

.1 INT 5.1E Alkyd. Budget Grade.

Prime coating by steel supplier - ensure it is compatible with the finish paints.

1st coat - Alkyd Metal Primer

2nd coat - Alkyd

.8 Interior Metal Surfaces Subject to High Contact - including doors, frames, handrails, guardrails, and ladders.

.1 INT 5.3C Alkyd (over cementitious primer). Premium Grade.

Gloss Level 4

Prime coating by supplier - ensure it is compatible with the finish paints.

1st coat - Cementitious Primer

2nd coat - Alkyd

3rd coat - Alkyd

.9 Interior Galvanized Metal - Including exposed mechanical ducts, exposed steel deck and acoustical deck.

.1 INT 5.3C Alkyd (over cementitious primer). Premium Grade

Prime coating by supplier - ensure it is compatible with the finish paints.

1st coat - Cementitious Primer

2nd coat - Alkyd

3rd coat - Alkyd

.10 Interior Woodwork - Clear Finish

.1 Wood Doors and Frames, Moldings, etc.

INT. 6.3K - Polyurethane Varnish; Premium Grade; G4 "Satin" Finish.

1st coat - Polyurethane Varnish - reduced

2nd coat - Polyurethane Varnish

3rd coat - Polyurethane Varnish

.2 Wood Panelling and Casework

INT. 6.3Q - Waterborne Varnish Clear, Premium Grade, G5-Semigloss.

1st coat - Waterborne Varnish

2nd coat - Waterborne Varnish

3rd coat - Waterborne Varnish

.11 Gypsum Board - including all gypsum board, unless indicated otherwise.

.1 Vertical Surfaces:

- INT 9.2B - High Performance Architectural Latex; Premium Grade;
Gloss Level 3
After the prime coat have Drywaller review their work and repair all major problems.
1st coat - Latex Primer Sealer
2nd coat - HIPAC Latex
3rd coat - HIPAC Latex
- .2 Ceilings:
INT 9.2B - High Performance Architectural Latex; Premium Grade;
Gloss Level 2
After the prime coat have Drywaller review their work and repair all major problems.
1st coat - Latex Primer Sealer
2nd coat - HIPAC Latex
3rd coat - HIPAC Latex
- .12 Gypsum Board in High Moisture Areas - gypsum board in all washrooms, change rooms, kitchen areas, janitor areas, including ceilings in change rooms and showers.
- .1 INT 9.2F 2-Component Epoxy ("Tile-Like").
After the prime coat have Drywaller review his work and repair all major problems.
Waterborne Finish, Premium Grade: G5 - Semi-Gloss
1st coat - Latex Primer Sealer.
2nd coat - Epoxy.
3rd coat - Epoxy.
- .13 Asphalt Traffic Marking - paint 100 mm wide lines and 300 high numbers and lettering to pavement to indicate parking stalls, directional arrows and cross walks and as indicated on drawings. Generally all line and lettering to be white. Curbs, where there is no parking, to be yellow. Handicapped symbol to be white with no background.
- .1 EXT 2.1A Traffic Marking Paint (Latex)
1st coat - 7 mil dry thickness - Traffic Marking Paint.
- .14 Cementitious Board – exposed cement board.
- .1 Fire Rated Epoxy Paint. Use pick resistant Epoxy Caulk at perimeter.

3.6 EXTENT OF CONTRACT

- .1 The intent of this Contract is to paint all interior and exterior surfaces of the new building. Listed below are pre-finished items and areas not to be painted. The

painter shall familiarize himself with items prefinished by others. The lists are not intended to be complete or exclusive.

- .2 Areas not to be painted:
 - .1 Aluminum work (windows, skylights, aluminum doors and screens).
 - .2 Millwork (cabinets, wood panels, window sills, custom furniture items, shelves, and shop finish).
 - .3 Acoustic tile and acoustic fabric or vinyl finishes.
 - .4 Mechanical and Electrical equipment pre-painted and within mechanical rooms.
 - .5 Flashings to pre-finished metal siding.
 - .6 Metal cladding.

3.7 CLEANING

- .1 Promptly as the work proceeds and on completion of the work remove all paint where spilled, splashed or spattered.
- .2 During the progress of the work, keep the premises free from any unnecessary accumulation of tools, equipment, surplus materials and debris.

PART 1 GENERAL

1.1 SCOPE OF WORK

- .1 The work of this section includes the supply and installation of all signage called for on drawings and herein specified.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with General Conditions.
- .2 Clearly indicate size and description of components, base materials, and attachment devices, etc..

1.3 GUARANTEE

- .1 Provide a written guarantee that components will be warranted against material and design and workmanship defects for a period of one (1) year after Departmental Representative's Certificate of Substantial Completion or they shall be replaced or repaired at no cost to the Department Representative.

PART 2 PRODUCTS

2.1 CAST ALUMINUM SIGN

- .1 Supply and install cast aluminum letter identification sign to be located as indicated on the drawings, complete with fasteners to suit substrate. Letters to be "Hewco" Helvetica medium, 300 mm high, 713 profile, brushed aluminum with clear lacquer finish or baked on enamel, colour to be chosen by Department Representative, supplied complete with mounting studs and spacing template. Copy to be provided by Department Representative, allow for 69 letters.

2.2 STREET NUMBER SIGN

- .1 200 mm high, reverse self-adhesive vinyl street number to be applied to inside of glass above main entrance doors. The number shall be up to 5 digits in Helvetica Medium Style and the colour shall be white. Exact location of street number to be confirmed on site by Department Representative.

2.3 NUMBER PLATES 'A' – LAMICOID TYPE (Building Operations Room Number)

- .1 Provide one 25 mm x 50 mm Lamicoid sign. Letters/numbers to be 19 mm high capitals, Helvetica Medium style. Colour shall be white character engraved into black background.
- .2 Attach signs with double-sided foam tape and silicone adhesive.
- .3 One sign of this type is to be applied to the head frame at every interior door unless otherwise indicated (see Sign list for painted Room numbers on door frame). Mount above the latch side of the door.

- .4 Generally room identification letter/numbers for this sign type shall be as per architectural floor plans.
- .5 All drawings and samples to be submitted for Department Representative approval.

2.4 ACRYLIC SIGN TYPE 'B' - 6 mm (All Interior signs except Lamicoid)

- .1 Room number shall be recess mounted into a recess created in the sign face. Acrylic solvent is to be used to melt and permanently bond raised text onto the sign face. All raised text, characters, etc. are to have a beveled edge on the raised portion. Indicated acrylic raised pictograms, numbers and letters to be 0.8 mm raised from the surface. Colour: White. Vinyl lettering is not acceptable. Sans Serif Helvetica Medium Style or approved alternative. Not raised letters and numbers shall be reverse screen printed to back side of sign panel, colour white unless otherwise indicated. Raised letters or pictograms shall be glued to sign face with non-removable adhesive.
- .2 PVC back panel colour: Black.
- .3 Use black double tape only for sandwich panel assembly and to past the sign on glass where necessary. Where signs are mounted on sidelights or windows, a matching vinyl opaque backing plate of equal size and finish shall be mounted on the inside face of the glass behind the sign.
- .4 Background to be screen printed to back side of sign panel with colour silver metallic.
- .5 Note: The indication for the location of the signs on plan will be issued separately.
- .6 Sign work for the disabled (handicapped washrooms) shall be to material standards above and to the standards required by the Building Requirements for Persons with Disabilities, Section 3.8 of the Building Code.
- .7 Signs to all washrooms shall have International Symbols for Men and Women plus room name.
- .8 Washrooms with handicapped facilities shall also have the International Symbol for Accessibility.

Schedule - (Note room numbers are for reference to the numbers shown on project construction drawing floor plans; actual numbers will be 3 digits in sequence with number established by Department Representative.) Allow for a 3 digit number or letter/number combination on every sign to be confirmed by Department Representative prior to manufacturing.

SIGN LOCATION S (Plan Room No.'s)	QUANTITY (Type B Acrylic)	ROOM NAME	SYMBOL	NAME ON SIGN	NOTES
100	NONE	VESTIBULE	--	--	
101	3	LOBBY	--	YES	
102	2	MULTI-PURPOSE	--	YES	name TBC (PROJECT ROOM)
103	1	HC/WC	UNISEX + HC	YES	
104	2	MEETING RM	--	YES	
105	1	STORAGE	--	YES	
106	1	FITNESS	--	YES	
107	1	EQUIPMENT	--	YES	
108	1	HC/WC	UNISEX + HC	YES	
109	1	MECHANICAL	--	YES	
110	1	ELECTRICAL	--	YES	
111	NONE	VESTIBULE	--	--	
112	3	NO PUBLIC ACCESS	--	YES	Doors 101, 102B, and 104B. Located non-corridor side
114	1	(15 LETTER SIGN)	--	YES	1 additional name plate slot required
115	1	FILE ROOM	--	YES	
116	1	UNISEX LOCKERS / WC	UNISEX + CHANGE ROOM	YES	
117	1	UNISEX WC / SHOWER	UNISEX + HC	YES	
118	1	(15 LETTER SIGN)	--	YES	
119	1	(14 LETTER SIGN)	--	YES	
120	1	TEL	--	YES	
121	1	(3 LETTER SIGN)	--	YES	

SIGN LOCATION S (Plan Room No.'s)	QUANTITY (Type B Acrylic)	ROOM NAME	SYMBOL	NAME ON SIGN	NOTES
122	1	(11 LETTER SIGN)	--	YES	
123	1	JANITOR	--	YES	
201	1	(9 LETTER SIGN)	--	YES	
202					
203	1	(5 LETTER SIGN)	--	YES	
204	1	(9 LETTER SIGN)	--	YES	
205	NONE	--	--	--	
206		WC	UNISEX	YES	
207	1	SHOWER	--	YES	
208	1	JANITOR	--	YES	
209	NONE	-	--	--	see note .3 below
210	NONE	-	--	--	see note .3 below
211	1	(13 LETTER SIGN)	--	YES	
212	1	(16 LETTER SIGN)	--	YES	
DOOR 112B	1	(10 LETTER SIGN)	--	YES	
301	NONE				
302	1	COLD STORAGE	--	YES	
303	1	FOUND ITEMS	--	YES	

Notes:

- .1 See attached drawings for sign types.
- .2 All drawings and samples to be submitted for Department Representative's approval.
- .3 Cell name and numbers to be paint applied on door. See architectural drawings.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install as indicated on the drawings and specifications to achieve vandal resistance and a visually pleasing effect.
- .2 Install Type 'B' signs in accordance with the requirements of Section 3.8.3.1 in the National Building Code, centred 1350 mm above finish floor, and at a distance of 150 mm from the strike jamb of the door.
- .3 Confirm sign locations with Department Representative before installation.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

- .1 This section includes supply and installation of washroom accessories as indicated on drawings and herein specified. Coordinate with Department Representative for locations of blocking for Department Representative-supplied items.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- .1 Rough Carpentry Section 06 10 00
.2 Glass and Glazing (frameless mirrors) Section 08 80 50

1.3 SHOP DRAWINGS

- .1 Submit shop drawings and/or catalogue illustrations in accordance with General Conditions.
.2 Clearly indicate size and description of components, base material, finish inside and out, attachment devices, description of rough-in framing required for anchors, etc.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Manufacturers named are the standard of acceptance. Alternate equipment meeting the named manufacturers' quality, and specifications will be considered as alternatives.
.2 Grab Bars - 33 mm diameter, peened grip, 18 gauge Type 304 stainless steel tube with 76 mm diameter x 13 mm thick concealed mounting flanges with screws to suit grounding material to meet loading standards. ADA Compliant.
.1 120 degree angle, with 600 mm legs for beside toilets in accessible washrooms;
.2 300 mm horizontal bar for behind non-bolt-down tank toilets in accessible washrooms;
.3 610 mm x 915 mm horizontal shower bars in accessible shower stalls (where applicable –Room 117). **No grab bars or accessories in Room 207.**
.3 Fasteners - screws and bolts hot dip galvanized. Expansion shields shall be fibre, lead or rubber as recommended by fixture manufacturer to provide strength

- of fastening required by building codes. If on metal toilet partitions through bolts to be used.
- .4 Sanitary Napkin Disposal Bins - Satin-finish stainless steel. Seamless flange, tumbler lock. Self-closing panel to cover disposal opening. Removable, leak-proof receptacle approximately 4.6 L (1.2-gal). 100mm recess, and approximately 285mm wide x 395mm high. ADA compliant.
 - .5 Shower Curtain Rod - Extra Heavy Duty 32 mm (1¼") diameter, 18 gauge type 304 stainless steel with satin finish, complete with 65 mm square mounting flanges. **No shower curtain rod or accessories in Room 207.**
 - .6 Shower Curtains - waterproof, mildew and bacteria resistant, non-combustible opaque matte white vinyl shower curtains, 0.2 mm thick, complete with non-corroding nickel plated grommets along top, every 150 mm. Bottom and sides hemmed. Minimum 1780 mm wide x 1830 mm high. **No shower curtain or accessories in Room 207.**
 - .7 Toilet Tissue Dispensers - Satin-finish stainless steel unit with stainless steel dispensing mechanism. Flat face door with tumbler lock. Holds two rolls up to 135mm (5 1/4") diameter. Extra roll automatically drops in place when bottom roll is depleted. Theft-resistant, heavy-duty spindles. Approximate dimensions: 155mm x 280mm x 150mm. ADA compliant.
 - .8 Shower Curtain Hooks - Type 304 stainless steel for use on 25 mm and 30 mm diameter shower curtain rods. **No shower curtain hooks or accessories in Room 207.**
 - .9 Mop Holders (MH) -Surface-mounted stainless steel channel. 915mm (36") long. Type 304 stainless steel, satin finish. Minimum three (3) anti-slip mop holders with spring-loaded rubber cam grips for mop handles ranging 20–30mm in diameter.
 - .10 Waste Containers – Semi-recessed waste receptacle and paper towel dispenser: Folded paper towel module and 12-gallon (approx..) waste receptacle module which can be interchanged with an automatic, universal or touch-free roll towel module and 18-gallon waste receptacle module, respectively. Satin-finish stainless steel. Seamless flange. Dispenses approximately 600 C-fold or 800 multifold towels. Removable waste receptacle to be locked into cabinet. 205mm (8") deep receptacle to extend max. 105mm (4 1/2") from wall. 100mm (4") deep recess in wall. Rough opening approximately 405 x 1390 x 100mm. ADA compliant.
 - .11 Robe Hooks – Double robe (two-sided) hook, bright-polished or satin finish stainless steel. 100mm (3 15/16") wide contoured hook is. Approximately 50mm x 50mm flange. Projects approximately 50mm (1 7/8") from wall. Install two (2) in Room 117, in location shown in elevation on Architectural drawing 345. **No hooks or accessories in Room 207.**

- .4 Shower Seat- Solid Phenolic Reversible Folding Shower/Dressing Area Seat. One-piece 8mm thick solidly fused plastic laminate with matte finish melamine surfaces with integral slots for water drainage. Secured to 18-8S, type 304 satin finish stainless steel frame fabricated from 1.6mm (16gauge) 30mm square tubing and 1.2mm (18gauge) 25mm dia. Seamless tubing. Complete with 2 mounting flanges, heavy gauge baseplate, and guide bracket, all made of type 304 stainless steel with satin finish. Spring - type 301 stainless steel, 0.6mm (24gauge), spot welded to baseplate. ADA Compliant. Install one (1) in Room 117 in location shown on sheet 345, architectural drawings. **No seat or accessories in Room 207.**

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Ship in protective wrappings.
- .2 Locate accessories where shown on drawings and as required by building codes for accommodation of persons with disabilities. Where in doubt request Departmental Representative to determine exact locations on site.
- .3 Wood backing shall be installed behind all units, including items scheduled as supplied by Department Representative.
- .4 Note units to be installed recessed or semi-recessed and provide rough openings per manufacturer's recommendations.
- .5 Install units plumb, level and square to building lines, securely fastened against vandalism using tamper proof screws and bolts.

3.2 SCHEDULE

- .1 Accessories part of Contract:
- .1 Grab Bars - installation according to supplier's instructions to meet National Building Code 2010 for load capacity and other requirements. In wheelchair accessible toilet rooms and stalls: One angled bar beside toilet, and either one straight 600mm bar or two 300 mm bars behind flush valve type toilets. Grab bar not required behind toilets with bolt-down tanks. 610 mm x 915 mm horizontal shower bars in accessible shower stalls (Room 207 shower excluded).
- .2 Sanitary Napkin Disposal Bins - beside each female toilet and unisex handicapped accessible toilet rooms 500 mm above floor and 300 mm back from front of toilet.
- .3 Shower Curtain Rod - one for each shower compartment. (Room 207 shower excluded).

- .4 Shower Curtain - one for each shower stall. (Room 207 shower excluded)
- .5 Mop Holder (MH) - one adjacent each floor sink in Janitors' Rooms.
- .6 Semi-Recessed Waste Receptacle and Paper Towel Dispenser - one for each washroom.
- .7 Robe Hooks – Two in change area adjacent to shower in location as shown in drawings (Room 207 shower excluded).
- .8 Toilet Paper Dispenser - one beside each toilet.
- .9 Soap Dispensers - for each sink in locations shown on drawings.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 21 13 13 – Wet Pipe Sprinkler Systems.
- .2 Section 21 30 00 – Fire Pumps.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 10-2010, Standard for Portable Fire Extinguishers.

1.3 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit two (2) copies WHMIS MSDS - Material Safety Data.
- .3 Provide shop drawings.
- .4 Quality control submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures and maintenance.
 - .2 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3, FIELD QUALITY CONTROL.

- .5 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20 - Waste Managing and Disposal.

PART 2 PRODUCTS

2.1 MULTI-PURPOSE DRY CHEMICAL EXTINGUISHERS

- .1 Stored pressure rechargeable type with hose and shut-off nozzle, ULC labelled for A, B and C class protection.
- .2 Size 4.5 kg (10 lbs) unless indicated otherwise on drawings.

2.2 CARBON DIOXIDE FIRE EXTINGUISHER

- .1 Stored pressure rechargeable type with hose and shut-off nozzle, ULC labeled for B and C class protection.
 - .1 Size 9.1 kg (20 lbs).
 - .2 Stored in Electrical room.

2.3 EXTINGUISHER BRACKETS

- .1 Type recommended by extinguisher manufacturer.

2.4 CABINETS

- .1 Flush and semi-recessed type as indicated, constructed of 1.6 mm thick steel, 180 degrees opening door of 2.5 mm thick steel with latching device.
- .2 Cabinet to maintain fire resistive rating of construction in which they occur.
- .3 Cabinet door: with 5 mm full glass panel.
- .4 Finish:
 - .1 Tub: prime coated.
 - .2 Door and frame: No.4 satin finish stainless steel.

2.5 IDENTIFICATION

- .1 Identify extinguishers in accordance with recommendations of ANSI/NFPA 10 CAN/ULC-S508.
- .2 Attach bilingual tag bar code or label to extinguishers, indicating month and year of installation. Provide space for service dates.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install or mount extinguishers in cabinets or on brackets as indicated in accordance with NFPA 10.
 - .1 For fire rated cabinets, fire rate sealant shall be used around the cabinet penetrations to provide continuity between the wall and the cabinet.

3.3 FIELD QUALITY CONTROL MANUFACTURER'S FIELD SERVICES

- .1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

Part 1 General

1.1 SECTION INCLUDES

- .1 Locker units with hinged doors.
- .2 Metal tops and filler panels.

1.2 RELATED SECTIONS

- .1 Section 06 10 13 - Wood Blocking and Curbing:
 - .1 Wood base construction.
- .2 Section 09 65 10 - Resilient Flooring: rubber base

1.3 REFERENCES

- .1 ASTM A653/A653M-10 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

1.4 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide data on locker types, sizes and accessories.
- .3 Shop Drawings: Indicate locker plan layout, numbering plan, colour chart and selected options.

1.5 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 01 61 00: Transport, handle, store, and protect products.
- .2 Protect locker finish and adjacent surfaces from damage.

Part 2 Products

2.1 MANUFACTURERS

- .1 Lincora; Product: Corridor Series 50 Nova: Standard single-point latch .
- .2 Other acceptable manufacturers offering functionally and aesthetically equivalent products.
 - .1 Hadrian; Product: Emperor.
 - .2 Montel; Product: Corridor.

2.2 ACCESSORIES

- .1 For each locker:
 - .1 Two, single prong wall hooks, Flat 1/2 x 1/8.
 - .2 One, Number Plate, Plastic.

- .3 One, preformed solid plastic insert mat for locker floor.

2.3 FABRICATION

- .1 Locker Units:
 - .1 Width: 305 mm.
 - .2 Depth: 380 mm.
 - .3 Height: 1830 mm.
 - .4 Configuration: single tier.
 - .5 Mounting: Surface mounted.
 - .6 Top: Sloped metal with closures.
 - .7 Locking: Equipped for combination locks.
 - .8 Ventilation Method: Door louvres.
 - .9 Type: Quiet.
- .2 Locker Body: Formed and flanged; with steel stiffener ribs; electric spot welded.
- .3 Frames: Formed channel shape, welded and ground flush, welded to body with resilient gaskets and latching for quiet operation.
- .4 Doors: Hollow channel construction, 30 mm, thick; welded construction, channel reinforced top and bottom with intermediate stiffener ribs, grind and finish edges smooth.
- .5 Hinges: One continuous piano hinge; weld securely to locker body and door.
- .6 Number Plates: Provide rectangular shaped plastic plates. Form numbers, 12.5mm high of Times New Roman font style with ADA designation, in contrasting colour.
- .7 Form recess for operating handle and locking device.
- .8 Finish edges smooth without burrs.
- .9 Provide two end panels.

2.4 FINISHES

- .1 Factory applied powder coat finish.
- .2 Paint locker units of one colour throughout.
- .3 Colour: as selected from manufacturer's standard range.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.

3.2 INSTALLATION

- .1 Install lockers to manufacturer's written instructions.

- .2 Install lockers plumb and square.
- .3 Secure lockers with anchor devices to suit substrate materials. Minimum pullout force 445N.
- .4 Install sloped tops.
- .5 Install accessories.
- .6 Replace components that do not operate smoothly.

3.3 CLEANING

- .1 Section 01 74 00: Cleaning installed work.
- .2 Clean locker interiors and exterior surfaces.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

- .1 The work of this section includes supply and installation of metal storage shelving as indicated on drawings and specified herein.

1.2 REFERENCE STANDARDS

- .1 Do metal storage shelving work to CGSB 44-GP-7+Amdt-Dec-76. Type 2 except where specified otherwise.

1.3 DESIGN CRITERIA

- .1 Design and construct metal storage shelving to support uniform load of 182 kg. (400 lbs.) with maximum deflection of 1/180th of span.
- .2 Provide shelving widths and lengths to suit layout on floor plans. Typical widths are 305, 381 and 610 mm. Lengths as indicated on drawings and as required to fill the available space.
- .3 Design shelving to accommodate vertical adjustment to shelves in 50 mm increments and to permit easy assembly, expansion, dismantling and re-use of shelving components.
- .4 All units of shelving as indicated on plans shall be six (6) shelves high = 2200 mm including the top shelf.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with General Conditions.
- .2 Indicate shelving layouts, number of bays, number of shelves, number and size of drawers, bins, number of dividers, system of bracing and anchoring devices.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Steel sections and plates: to CAN3-G40.21-M81, type 400W.
- .2 Steel bolts, nuts and washers: to CSA B34-1967 (R1972).
- .3 Welding Materials: to CSA W59-1977.

2.2 COMPONENTS

- .1 Uprights: roll formed steel angles or tees with perforations to accommodate shelves and other components. Size and thickness of angles or tees shall support specified total load.

- .2 Shelves: break formed sheet metal, reinforced to carry specified loads. Punch holes in shelves to accommodate dividers and other components.
- .3 Braces: provide sway braces for open type shelving. Use side sway braces on two exposed sides of each rack and at alternate bays. Use back sway braces on two end sections of each bank and on alternate bays.
- .4 Base Plates: purpose made metal or plastic plates to fit uprights and to protect floor surfaces.

2.3 FINISHES

- .1 Finish shelving in manufacturer's standard colour.
- .2 Condition metal by applying one coat of metal conditioner to CGSB-31-GP-107M.
- .3 .Apply one coat type 2 primer to CGSB 1-GP-88e and bake to hard durable finish.

2.4 SHELVING SCHEDULE

<u>Room No.</u>	<u>Room Name</u>	<u>Dimension (mm)</u>	<u>No.</u>
123	Janitor	381 deep x 914 wide	x2
208	Janitor	381 deep x 914 wide	x1

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install metal storage shelving in accordance with reviewed layout. Confirm spacing of shelving with Departmental Representative before installing.
- .2 Brace, secure and anchor shelving units in place. Bolt shelving units to wall where possible, for seismic restraint.
- .3 Make good baked enamel surfaces damaged during shipment or installation.

END OF SECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

- .1 The work of this section includes supply and installation of miscellaneous special items called for on drawings and herein specified.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings or catalogue illustrations in accordance with General Conditions.
- .2 Clearly indicate size and description of components, base materials, finish inside and out, hardware and locks, attachment devices, description of rough-in framing required for anchors, etc. the tendering authority prior to bidding an alternative product..

1.3 GUARANTEE

- .1 Provide a written guarantee that components will be warranted against material and design and workmanship defects for a period of one (1) year after Certificate of Substantial Completion or they shall be replaced or repaired at no cost to the Department Representative.

PART 2 PRODUCTS

2.1 BICYCLE RACKS

- .1 Standard of Acceptance: Urban Rack, tel. 1-800-717-8881, Model "Urban Staple Rack" fabricated from 60 mm O.D. stainless steel pipe complete with solid locking bar welded to each vertical member, or approved equal.
- .2 Racks shall be formed from stainless steel pipe.
- .3 Installed with tamper-proof security bolts.
- .4 Number required: one (1) unit which will house two bikes, refer to landscape plan for location.

2.2 FLAG POLE

- .1 Standard of Acceptance: John Ewing & Co. Ltd. Model HTA-25 & All-Canadian Flagpole Co. Inc. or approved equal.
- .2 Pole shall be standard swaged section AA 6351-T6 aluminum alloy, with Ewing B7 tilting base, alloy AA6061, and "Econoline" stainless steel aircraft wire internal halyard, revolving non fouling finial with 150 mm ball, and sealed bearings, lockable cleat box. Finish of pole; clear anodized to CE/AN/0.0006.
- .3 Provide standard lightning grounding rod.

- .4 Provide template and specifications for concrete base and anchor bolt layout.
- .5 Provide locking lug on tilt pole mechanism.
- .6 Height: 7620 mm height
- .7 Refer to details in civil drawings.

2.3 ENTRANCE FLOOR GRILLES

- .1 Extruded 6105-T5 aluminum alloy with 3/4" deep tread rails joined by an EPDM hinge and cushion to compromise the overall grid length (traffic direction). The hinge shall be complete with perforations between each tread rail for drainage, unless otherwise specified. Frameless (concrete slab depression provided).
- .2 Manufactured: C-S Group, Pedisystems, PediTred G4.
- .3 Alternate Manufactures include: Bolar, K.N. Crowder
- .4 Finish: Anodized Aluminum.
- .5 Insert: Poured Abrasive Insert Colour: 'Wrought Iron'
- .6 Locations: Vestibules 100 and 111.

2.4 TV WALL MOUNT BRACKET

- .1 'Full motion' wall mount steel bracket for flat panel TV up to 39" in diagonal screen size. Colour: Black.
- .2 Supply and install bracket in Room 101 LOBBY.

2.5 INSTALLATION

- .1 Install work plumb, true, square and level, free from distortion or defects affecting appearance or performance and according to manufacturer's instructions.
- .2 Adjust moving parts to operate smoothly with normal manual exertion.

PART 1 GENERAL

1.1 SCOPE OF WORK

- .1 The work of this section includes supply and installation of flush-mounted secure gun lockers called for on drawings and herein specified and scheduled.

1.2 GUN LOCKERS

- .1 General: Doors, doorframes, and body parts shall be made of steel. All steel to be free from imperfections and capable of taking a high-grade powder coat finish. The surfaces of the steel shall be cleaned thoroughly in a multi-stage process to inhibit corrosion and increase the durability of the applied finish. All parts shall then be finished with a powder coat finish. Finish shall be baked on. All manufactured parts shall be the same finish.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings or catalogue illustrations in accordance with General Conditions.
- .2 Clearly indicate size and description of components, base materials, finish inside and out, hardware and locks, attachment devices, description of rough-in framing required for anchors, etc. the tendering authority prior to bidding an alternative product

1.4 APPROVED MANUFACTURERS

- .1 The products listed herein are based on a specific manufacturer to establish a standard of quality and minimum requirements. The Drawings and Specifications are based upon DMS metal gun lockers, as manufactured by Spacesaver Corporation (1-800-255-8170). Products by any other manufacturers will be considered provided they comply with technical requirements and match the specified product in layout, configuration, construction, appearance and finish, in accordance with the design concept and intent and must be approved by the Department Representative.
- .2 Manufacturer is subject to compliance with requirements for products provided by the following:
Spacesaver Corporation
1-800-255-8170.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver and store all materials in accordance with manufacturer's directions.
- .2 Comply with all other manufacturer's instructions regarding care and installation of materials to fulfil guarantee requirements.

- .3 All materials to be properly packaged for protection during transit and onsite handling. Inspect windows upon delivery for damage. Unless minor defects can be made to meet the Departmental Representative's specifications and satisfaction, damaged parts should be removed and replaced.

1.6 WARRANTY

- .1 Provide the manufacturers four (4) year limited parts and labour warranty.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 16 gauge sheet steel: commercial quality, stretcher levelled, or roller levelled to stretcher-levelled flatness, free of buckling, scale and surface imperfections.
- .2 Fasteners; 5/32-inch steel rivets..
- .3 Hardware and Equipment; Manufacturer's standard product.

2.2 COMPONENTS

- .1 Body: Welded Modular Construction; Form backs, tops, bottoms, sides, and intermediate partitions from steel sheet; fabricated to form tight joints between components and no apparent gaps. Comply with the following:
 - .1 Back-Material Sheet Thickness: .0598-inch 16-gauge steel.
 - .2 Exposed Ends: Form exposed ends of non-recessed lockers from minimum .0598-inch, 16-gauge, steel sheet.
- .2 Trim Surround for Flush Mount:
 - .1 Single piece of formed .0598-inch, 16-gauge steel.
 - .2 Surround mounted to locker with 5/32-inch steel rivets.
 - .3 Holes for fastening to the wall must accept minimum 1/4-inch diameter fastener.
- .3 Doors: One-piece steel sheet, formed into Pan shape. Fabricate to prevent flexing when opening or closing, and to swing open approximately 170 degrees. Comply with the following:
 - .1 Sheet Thickness: .0478-inch, 18-gauge, minimum.
 - .2 Provide bumpers for cushioning of door closing.
 - .3 Solid weld corners and polish smooth.
- .4 Hinges: Steel, heavy duty, continuous, piano hinge 1.5-inch open, .062-inch thick, 1/8-inch pin, 1/2-inch knuckle: full height of door. One end of hinge welded to prevent the removal of the pin. Weld to door and attach to doorframe with factory-installed fasteners that are completely concealed and tamper resistant when door is closed.
- .5 Locks: Tube locks keyed different with master keys supplied.

2.3 GUN LOCKER ACCESSORIES

- .1 Number Plates: Manufacturer's standard etched, embossed, or engraved, plastic number plates with numerals at least 1/2-inch high. Numbering system shall be a three-digit number, sequenced as specified. Plates to be attached by two (2) aluminum rivets and centred near the top on each door.

2.4 SCHEDULE OF LOCATIONS

No. of Units	Room Number	Mode
1x	RM 201	EDHGF04V flush-mounted 4 door unit
1x	RM 112	EDGHF06 flush-mounted 6 door unit

Note: Locations as shown on architectural floor plan.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install work plumb, true, square and level, free from distortion or defects affecting appearance or performance and according to manufacturer's instructions.
- .2 Adjust moving parts to operate smoothly with normal manual exertion.

Part 1 General

1.1 SECTION INCLUDES

- .1 Manual, chain-operated, horizontal window roller shades.

1.2 RELATED SECTIONS

- .1 Section 06 11 00 – Wood Framing: Building framing members.
- .2 Section 09 22 16 – Non Structural Metal Stud Framing.

1.3 SYSTEM DESCRIPTION

- .1 Provide for infinite positioning of window shade.
- .2 Noise reduction seals for sound isolation and absorption of mechanism noise.
- .3 Shade Orientation: Shade cloth to roll at window side of roller.
- .4 Provide for smooth and quiet operation.

1.4 SUBMITTALS FOR REVIEW

- .1 Section 01 33 00: Submission procedures.
- .2 Product Data: Provide manufacturer's data sheets describing components, accessories, dimensions, tolerances for window openings required, colours and textures.
- .3 Shop Drawings: Indicate dimensions in relation to window jambs, operator details, top rail, anchorage details, hardware and accessory details, required clearances and conditions between adjacent blinds.
- .4 Samples: Submit two (2) sets of 300 mm long samples of each visible-to-view component, indicating colour, surface texture and sheen.

1.5 WARRANTY

- .1 Section 01 78 10: Warranties.
- .2 Provide a five (5) year warranty to include coverage for failure to meet specified requirements.

Part 2 Products

2.1 MANUFACTURERS

- .1 Hunter Douglas; Product: Quantum Dual Roller System.
- .2 Other acceptable manufacturers offering functionally and aesthetically equivalent products.
 - .1 Draper; Product: Dual Roller Flexshade.
 - .2 Silentgliss; Product: 4810 Double Function.

- .3 Substitutions: Refer to Section 01 62 00.

2.2 COMPONENTS

- .1 Horizontal Shade Band:
 - .1 Assembly: Fabric, internal bottom bar, attachment of shade bands to roller tube.
 - .2 Fabric: Single thickness, non-ravelling, 0.76 mm thick, vinyl fabric, woven from 0.46 mm diameter extruded vinyl yarn.
 - .1 Types: One (1) Opaque, One (1) approximately 30% openness,
 - .2 Colour: Selected from manufacturer's available range.
 - .2 Internal Tension Idler: Adjustable, to automatically control the amount of torque generated for constant smooth operation of the shade system, with automatic release during down-travel, and automatic engage during up-travel.
 - .3 Chain Drive: Heavy duty, commercial grade sprocket, a planetary gear assembly for increased performance, speed ratio, smoothness, and balance to the chain and shade assembly.
 - .1 Operating Chain: No.10, heavy duty stainless steel bead chain, 40 kg load test.
 - .2 Chain Hold Down: To fully secure shade to chain holder.
 - .4 Mounting Brackets: 11 Gauge galvanized steel, snap on brackets for ceiling, wall, or recessed mount in ceiling.
 - .5 Light block angles: 19 mm L-shaped extruded aluminum angles for mounting to inside of jambs. Finish: clear anodized.
 - .6 Closure Box: One piece extruded aluminum box, closed on all four sides, top, back, sides, and bottom return.
 - .1 Closure Section: Square profile of 73 mm.
 - .2 Internal groove to accommodate a self cleaning brush.
 - .3 Gap brush on top back side of cassette to provide for a light seal.
 - .4 Wall Thickness: 1.52 mm.
 - .5 Closure End Caps: 2 mm. Delrin plastic with four countersunk flat headed screw holes.
 - .6 Finish: clear anodized.

2.3 FABRICATION

- .1 Provide manual shade chain drive window shade, of:
 - .1 Tension activated lifting mechanism with multi-layer concentric constant tension.
 - .2 Lifting mechanism with a memory tension lock.
 - .3 Shade to not require re-tensioning after removal for cleaning.
 - .4 Internally free-floating mechanism along grooved non-corrosive shaft, and reversible for future alterations and maintenance.

- .2 Factory assemble in a one piece container, closed on all four sides, with top, back, sides and bottom return of plastic injected-molded end caps.
- .3 Lifting mechanism to accommodate tension modules for maximum shade performance. Provide memory lock for tension modules to retain torque.
- .4 Mounting detail: surface mount inside aluminum glazing frame.

Part 3 Execution

3.1 EXAMINATION

- .1 Section 01 70 00: Verify existing conditions before starting work.
- .2 Examine substrate and conditions for installation.
- .3 Beginning of installation means acceptance of substrate and project conditions.

3.2 INSTALLATION

- .1 Install units and their accessories to manufacturer's instructions.
- .2 Securely screw end plugs to conceal exposed cut aluminum of exterior hem bar.
- .3 Securely anchor units plumb and level, using hardware and accessories to provide smooth operation without binding.

3.3 INSTALLATION TOLERANCES

- .1 Maximum variation of gap at window opening perimeter: 6 mm per 2.4 m (plus or minus 3 mm) of shade height.
- .2 Maximum offset from level: 3 mm.
- .3 Use manufacturer's edge clearance requirements for shades where the width-to-height ratio exceeds 1:3.

3.4 ADJUSTING

- .1 Adjust units for smooth operation.
- .2 Adjust shade and shade cloth to hang flat without waves, folds, or distortion.
- .3 Replace any units or components which do not hang properly or operate smoothly.

3.5 CLEANING

- .1 Section 01 74 00: Cleaning installed work.
- .2 Touch up damaged finishes and repair minor damage in a manner to eliminate evidence of repair. Remove and replace work that cannot be satisfactorily repaired.
- .3 Clean exposed surfaces and edges/ends, including metal and shade cloth, using non-abrasive materials and methods recommended by manufacturer. Remove and replace work which cannot be satisfactorily cleaned.

3.6 CLOSEOUT ACTIVITIES

- .1 Demonstration: Demonstrate operation method and instruct Department Representative's personnel in the proper operation and maintenance of the window shade assembly.

3.7 SCHEDULES

- .1 Room Locations: 102, 106, 113, and 114.

END OF SECTION

PART 1 GENERAL

1.1 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings; submit drawings stamped and signed by professional engineer registered or licensed in Province of Nova Scotia, Canada, where requested.
- .3 Shop drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
- .4 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
- .5 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .6 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.
 - .2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .3 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.

- .4 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .5 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .6 Approvals:
 - .1 Submit 3 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .7 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
 - .1 Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur..
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .9 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
 - .3 Submit to Departmental Representative for approval and make corrections as directed.

- .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
- .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

1.2 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.3 MAINTENANCE

- .1 Furnish spare parts in accordance with Section 01 78 010 - Closeout Submittals as required by equipment specification sections.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 10 - Closeout Submittals.
- .3 Provide following spare parts:
 - .1 Minimum 2 spare sprinkler heads of each type used in project.
 - .2 Minimum 2 sprinkler cages
 - .3 Minimum 2 cover plates assemblies.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 EXECUTION

3.1 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 90 00 - Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 DEMONSTRATION

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Departmental Representative will record these demonstrations on video tape for future reference.

3.5 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

3.6 ACCESS DOOR

- .1 Contractor to provide access doors as required for all equipment concealed in ceilings and walls. Reference section 08 31 13 Access Doors and Frames. his requirement is applicable for Divisions 21, 22, 23 and 25.
- .2 Contractor to coordinate with drywall contractor.

3.7 ROOF PENETRATIONS

- .1 Contractor is responsible for coordination with roofing contractor regarding equipment installation in vicinity of all roof penetrations.

PART 1 GENERAL

1.1 REFERENCES

- .1 National Fire Prevention Association (NFPA)
- .2 NFPA 13-2013, Standard for the Installation of Sprinkler Systems.
 - .1 NFPA 24-2013, Standard for the Installation of Private Fire Service Mains and Their Appurtenances.
 - .2 NFPA 25-2011, Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
- .3 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN4 S543-M984, Standard for Internal Lug Quick Connect Couplings for Fire Hose.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and data sheets, and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Nova Scotia, Canada.
 - .2 Indicate:
 - .1 Materials.
 - .2 Finishes.
 - .3 Method of anchorage
 - .4 Number of anchors.

- .5 Supports.
- .6 Reinforcement.
- .7 Assembly details.
- .8 Accessories.
- .4 Samples:
 - .1 Submit samples of following:
 - .1 Each type of sprinkler head.
 - .2 Signs.
 - .5 Test reports:
 - .1 Submit certified test reports for wet pipe fire protection sprinkler systems from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .6 Certificates:
 - .1 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .7 Manufacturers' Instructions:
 - .1 Provide manufacturer's installation instructions.
 - .8 Field Quality Control Submittals:
 - .1 Manufacturer's Field Reports: manufacturer's field reports specified.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide operation, maintenance and engineering data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals in accordance with ANSI/NFPA 20.
- .2 Manufacturer's Catalog Data, including specific model, type, and size for:
 - .1 Pipe and fittings.
 - .2 Alarm valves.
 - .3 Valves, including gate, check, and globe.

- .4 Water motor alarms.
- .5 Sprinkler heads.
- .6 Pipe hangers and supports.
- .7 Pressure or flow switch.
- .8 Fire department connections.
- .9 Excess pressure pump.
- .10 Mechanical couplings.
- .3 Drawings:
 - .1 Sprinkler heads and piping system layout.
 - .1 Prepare 760 mm by 1050 mm detail working drawings of system layout in accordance with NFPA 13, "Working Drawings (Plans)".
 - .2 Show data essential for proper installation of each system.
 - .3 Show details, plan view, elevations, and sections of systems supply and piping.
 - .4 Show piping schematic of systems supply, devices, valves, pipe, and fittings. Show point to point electrical wiring diagrams.
 - .2 Electrical wiring diagrams.
- .4 Design Data:
 - .1 Calculations of sprinkler system design.
 - .2 Indicate type and design of each system and certify that each system has performed satisfactorily in the manner intended for not less than 18 months.
- .5 Field Test Reports:
 - .1 Preliminary tests on piping system.
- .6 Records:
 - .1 As-built drawings of each system.
 - .1 After completion, but before final acceptance, submit complete set of as-built drawings of each system for record purposes.
 - .2 Submit Autocad 2008 drawing minimum.
- .7 Operation and Maintenance Manuals:
 - .1 Provide detailed hydraulic calculations including summary sheet, and Contractors Material and Test Certificate for aboveground and

underground piping and other documentation for incorporation into manual in accordance with NFPA 13.

1.4 DESIGN REQUIREMENTS

- .1 Design automatic wet pipe fire suppression sprinkler systems in accordance with required and advisory provisions of NFPA 13, for ordinary hazard occupancy by hydraulic calculations for uniform distribution of water over design area. All hydraulic designs shall include a minimum 34.5 kPa (5 psi) safety factor.
- .2 Include with each system materials, accessories, and equipment inside and outside building to provide each system complete and ready for use.
- .3 Design and provide each system to give full consideration to blind spaces, piping, electrical equipment, ducts, and other construction and equipment in accordance with detailed shop drawings.
- .4 Locate sprinkler heads in consistent pattern with ceiling grid, lights, and air supply diffusers. Centre sprinkler heads in a minimum of one direction in ceiling grid.
- .5 Devices and equipment for fire protection service: ULC approved for use in wet pipe sprinkler systems.
- .6 Seismic requirements provide and install to the requirements of NBCC and NFPA 13.
- .7 Location of Sprinkler Heads:
 - .1 Locate heads in relation to ceiling and spacing of sprinkler heads not to exceed that permitted by NFPA 13 for ordinary hazard occupancy.
 - .2 Uniformly space sprinklers on branch.
- .8 Water Distribution:
 - .1 Make distribution uniform throughout the area in which sprinkler heads will open.
 - .2 Discharge from individual heads in hydraulically most remote area to be 100% of specified density.
- .9 Density of Application of Water:
 - .1 Size pipe to provide specified density when system is discharging specified total maximum required flow.

- .10 Sprinkler Discharge Area:
 - .1 Area as defined in NFPA 13.
- .11 Outside Hose Allowances:
 - .1 Include allowance in hydraulic calculations of 946 lpm for outside hose streams.
- .12 Friction Losses:
 - .1 Calculate losses in piping in accordance with Hazen-Williams formula with 'C' value of 120 for steel piping, 150 for copper tubing, and 140 for cement-lined ductile-iron piping.
- .13 Water Supply:
 - .1 Base hydraulic calculations on available supply from fire pump to Section 21 30 00 – Fire Pumps.

1.5 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: company or person specializing in wet sprinkler systems with documented experience approved by manufacturer.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 10 - Closeout Submittals.
 - .2 Provide spare sprinklers and tools in accordance with NFPA 13.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Storage and Protection:
 - .1 Store materials indoors in dry location.
 - .2 Store and protect materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials.

PART 2 PRODUCTS

2.1 ABOVE GROUND PIPING SYSTEMS

- .1 Provide fittings for changes in direction of piping and for connections.
 - .1 Make changes in piping sizes through tapered reducing pipe fittings, bushings will not be permitted.
- .2 Perform welding in shop; field welding will not be permitted.
- .3 Conceal piping in areas with suspended ceiling.

2.2 PIPE, FITTINGS AND VALVES

- .1 Pipe:
 - .1 Ferrous: to NFPA 13.
 - .2 Copper tube: to NFPA 13.
- .2 Fittings and joints to NFPA 13:
 - .1 Ferrous: screwed, welded, flanged or roll grooved.

- .1 Grooved joints designed with two ductile iron housing segments, pressure responsive gasket, and zinc-electroplated steel bolts and nuts. Cast with offsetting angle-pattern bolt pads for rigidity and visual pad-to-pad offset contact.
- .2 Copper tube: screwed, soldered, brazed, grooved.
- .3 Plain-end fittings with mechanical couplings and fittings which use steel gripping devices to bite into pipe when pressure is applied will not be permitted.
- .4 Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 32 mm and larger.
- .5 Fittings: ULC approved for use in wet pipe sprinkler systems.
- .6 Ensure fittings, mechanical couplings, and rubber gaskets are supplied by same manufacturer.
- .7 Side outlet tees using rubber gasketed fittings are not permitted.
- .8 Sprinkler pipe and fittings: metal.
- .3 Valves:
 - .1 ULC listed for fire protection service.
 - .2 Gate valves: open by counterclockwise rotation.
 - .3 Provide rising stem valve beneath each alarm valve in each riser when more than one alarm valve is supplied from same water supply pipe.
 - .4 Check valves: flanged clear opening swing or spring actuated check type with flanged inspection and access cover plate for sizes 10 cm and larger.
 - .5 Provide gate valve in piping protecting machine rooms.
- .4 Pipe hangers:
 - .1 ULC listed for fire protection services in accordance with NFPA.

2.3 SPRINKLER HEADS

- .1 General: to NFPA 13 and ULC listed for fire services.
- .2 Sprinkler Head Type:
 - .1 Type A: flush pendant White glass bulb type.

- .1 Acceptable Material: Viking Model HQR-2, with Sprinkler Base Part No.10554, Sprinkler Identification No. VK410 and Escutheon Base Part No.10627.
- .2 Type B: upright chrome glass bulb type with protective cage.
- .3 Type C: Institutional Flush horizontal sidewall type.
 - .1 Acceptable Material: Viking Identification No. VK412(K5.6) with Escutheon Plate.
- .4 Type D: Flush architectural type
- .5 Type E: Semi-recessed pendent polished chrome or white, glass bulb type with ring and cup.
- .6 Type F: Architectural Flush horizontal sidewall type.
- .7 Type G: Non-freeze flush pendant type.
- .8 Type F: Back to back dual directional sprinkler.
- .9 All sprinklers installed in the attic space must be quick-response.
- .10 Provide nominal 1.2 cm orifice sprinkler heads.
- .11 Release element of each head to be of intermediate temperature rating or higher as suitable for specific application.
- .12 Heads located adjacent to heating equipment, such as unit heaters and radiant panels shall be rated for high temperatures.
- .13 Provide polished stainless steel ceiling plates or/and chromium-plated pendent sprinklers below suspended ceilings.
- .14 Provide corrosion-resistant sprinkler heads and sprinkler head guards in accordance with NFPA 13.
- .15 Provide sprinkler heads as indicated and as determined by hydraulic design requirements.
- .16 Deflector: not more than 75 mm below suspended ceilings.
- .17 Ceiling plates: not more than 25 mm deep.
- .18 Ceiling cups: not permitted.
- .19 Allow for 8 additional sprinklers for each head type.

2.4 SUPERVISORY SWITCHES

- .1 General: to NFPA 13 and ULC listed for fire service.

- .2 Valves:
 - .1 Mechanically attached to valve body, with normally open and normally closed contacts and supervisory capability.
- .3 Pressure or flow switch type:
 - .1 With normally open and normally closed contacts and supervisory capability.
 - .2 Provide switch with circuit opener or closer for automatic transmittal of alarm over facility fire alarm system.
 - .3 Connect into building fire alarm system.
 - .4 Connection of switch: Section 28 31 00.01 - Multiplex Fire Alarm system.
 - .5 Alarm actuating device: mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and instantly recycle.
- .4 Pressure alarm switch:
 - .1 With normally open and normally closed contacts and supervisory capability.

2.5 FIRE DEPARTMENT CONNECTION

- .1 Provide connections approximately 1.0 m above finish grade, location as indicated.
- .2 To NFPA 13 and ULC S543 listed, Siamese type.
- .3 Polished chrome plated exposed of approved two-way type with 2.5 inch, coordinate connection type with local fire department. Connection and identifying fire department connection escutcheon plate.
- .4 Thread specifications: compatible with local fire department.
- .5 Install a 90-degree elbow with drain connection at the low-point near each fire department connection to allow for system drainage to prevent freezing.

2.6 PRESSURE GAUGES

- .1 ULC listed and to Section 23 05 19.01 - Thermometers and Pressure Gauges - Piping Systems.
- .2 Maximum limit of not less than twice normal working pressure at point where installed.

2.7 PIPE SLEEVES

- .1 Provide pipe sleeves where piping passes through walls, floors, and roofs.
- .2 Secure sleeves in position and location during construction.
- .3 Provide sleeves of sufficient length to pass through entire thickness of walls, floors, and roofs.
- .4 Provide 2.5 cm minimum clearance between exterior of piping and interior of sleeve or core-drilled hole.
 - .1 Firmly pack space with mineral wool insulation.
 - .2 Seal space at both ends of sleeve or core-drilled hole with plastic waterproof cement which will dry to firm but pliable mass, provide mechanically adjustable segmented elastomeric seal.
 - .3 In fire walls and fire floors, seal both ends of pipe sleeves or core-drilled holes with ULC listed fill, void, or cavity material. Firestopping or sleeves to be provided as per Section 07 84 00 - Firestopping.
- .5 Sleeves in Masonry and Concrete Walls, Floors, and Roofs:
 - .1 Provide hot-dip galvanized steel, sleeves.
 - .2 Core drilling of masonry and concrete may be provided in lieu of pipe sleeves when cavities in core-drilled hole are completely grouted smooth.
- .6 Sleeves in Other Than Masonry and Concrete Walls, Floors, and Roofs:
 - .1 Provide 0.61 mm thick galvanized steel sheet.
- .7 Sleeves shall only be used in concrete block and cast-in-place concrete assemblies and then only if the sleeve is built into the assembly. Sleeves shall not be installed where penetrations are made following construction of an

assembly. Sleeves shall be finished flush with the fire separation unless a specific firestop system requires otherwise.

2.8 ESCUTCHEON PLATES

- .1 Provide one piece split hinge type metal plates for piping passing through walls, floors, and ceilings in exposed spaces.
- .2 Provide polished stainless steel plates in finished spaces.
- .3 Provide paint finish on metal plates in unfinished spaces.

2.9 SIGNS

- .1 Attach properly lettered metal signs to each valve and alarm device to NFPA 13.

2.10 SPARE PARTS CABINET

- .1 Provide metal cabinet with extra sprinkler heads and sprinkler head wrench adjacent to each alarm valve. Number and types of extra sprinkler heads as specified in NFPA 13.

2.11 BACKFLOW PREVENTOR

- .1 ULC Listed, double security check assembly with OS&Y valves on inlet and outlet.
- .2 Ductile iron body.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install, inspect and test to acceptance in accordance with NFPA 13 and NFPA 25.

3.3 PIPE INSTALLATION

- .1 Install piping straight and true to bear evenly on hangers and supports. Do not hang piping from plaster ceilings.
- .2 Keep interior and ends of new piping and existing piping thoroughly cleaned of water and foreign matter.
- .3 Keep piping systems clean during installation by means of plugs or other approved methods. When work is not in progress, securely close open ends of piping to prevent entry of water and foreign matter.
- .4 Inspect piping before placing into position.

3.4 ELECTRICAL CONNECTIONS

- .1 Sprinkler system electrical work relates to the connection of system components such as valve supervisory switches and system pressure pump to the Fire Alarm System and power distribution system, respectively.

- .2 Coordinate the supply and installation of sprinkler system components per electrical requirements included in Section 26 05 00 - Common Work Results – For Electrical and Section 28 31 00.01 - Multiplex Fire Alarm System.

3.5 DISINFECTION

- .1 Disinfect new piping and existing piping.
- .2 Fill piping systems with solution containing minimum of 50 parts per million of chlorine and allow solution to stand for minimum of 24 hours.
- .3 Flush solution from systems with clean water until maximum residual chlorine content is not greater than 0.2 part per million or residual chlorine content of domestic water supply.
- .4 Obtain at least two consecutive satisfactory bacteriological samples from piping, analyzed by certified laboratory, and submit results prior to piping being placed into service.

3.6 BURIED PIPING SYSTEM

- .1 Bury tape with printed side up at depth of 30 cm below the top surface of earth or top surface of subgrade under pavements.

3.7 FIELD PAINTING

- .1 Clean, pretreat, prime, and paint new systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories.
- .2 Apply coatings to clean, dry surfaces, using clean brushes.
- .3 Clean surfaces to remove dust, dirt, rust, and loose mill scale.
- .4 Immediately after cleaning, provide metal surfaces with 1 coat of pretreatment primer applied to minimum dry film thickness of 0.3 ml, and one coat of zinc chromate primer applied to minimum dry film thickness of 1.0 ml.
- .5 Shield sprinkler heads with protective covering while painting is in progress.
- .6 Upon completion of painting, remove protective covering from sprinkler heads.

- .7 Remove sprinkler heads which have been painted and replace with new sprinkler heads.
- .8 Provide primed surfaces with following:
 - .1 Piping in Finished Areas:
 - .1 Provide primed surfaces with 2 coats of paint to match adjacent surfaces.
 - .2 Provide valves and operating accessories with 1 coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil.
 - .3 Provide piping with 50 mm wide red enamel bands self-adhering red plastic bands spaced at maximum of 6 m intervals throughout piping systems.
 - .2 Piping in Unfinished Areas:
 - .1 Provide primed surfaces with one coat of red alkyd gloss enamel applied to minimum dry film thickness of 1.0 mil in attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material.
 - .2 Provide piping with 50 mm wide red enamel bands self-adhering red plastic bands spaced at maximum of 6 m intervals.

3.8 FIELD QUALITY CONTROL

- .1 Site Test, Inspection:
 - .1 Perform test to determine compliance with specified requirements in presence of Departmental Representative.
 - .2 Test, inspect, and approve piping before covering or concealing.
 - .3 Preliminary Tests:
 - .1 Hydrostatically test each system at 200 psig for a 2 hour period with no leakage or reduction in pressure.
 - .2 Flush piping with potable water in accordance with NFPA 13.
 - .3 Piping above suspended ceilings: tested, inspected, and approved before installation of ceilings.
 - .4 Test alarms and other devices.
 - .5 Test water flow alarms by flowing water through inspector's test connection. When tests have been completed and corrections

made, submit signed and dated certificate in accordance with NFPA 13.

- .4 Formal Tests and Inspections:
 - .1 Do not submit request for formal test and inspection until preliminary test and corrections are completed and approved.
 - .2 Submit written request for formal inspection at least 15 days prior to inspection date.
 - .3 Repeat required tests as directed.
 - .4 Correct defects and make additional tests until systems comply with contract requirements.
 - .5 Furnish appliances, equipment, instruments, connecting devices, and personnel for tests.
 - .6 Authority of Jurisdiction, will witness formal tests and approve systems before they are accepted.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .3 Site Tests:
 - .1 Testing to be witnessed by authority having jurisdiction.
 - .2 Develop, with Departmental Representative assistance, detailed instructions for O&M of this installation.
- .4 Performance Verification:
 - .1 Refer to commissioning plan

3.9 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.

- .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling.

PART 1 GENERAL

1.1 REFERENCES

- .1 National Fire Protection Association (ANSI/NFPA)
 - .1 NFPA 20-2013, Standard for the Installation of Stationary Fire Protection.
 - .2 NFPA 25-2011, Standard for Inspection, Testing and Manufacturer of Water-Based Fire Proofing System.
- .2 Underwriters' Laboratories of Canada (ULC)

1.2 RELATED SECTIONS

- .1 Section 21 05 01 – Common Work Results – For Mechanical.
- .2 Section 21 13 13 – Wet Pipe Sprinkler Systems.
- .3 Section 23 07 15 - Thermal Insulation for Piping.
- .4 Section 26 05 21 – Wires and Cables (0-1000 V).
- .5 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
- .6 Section 28 31 00.01 – Multiplex Fire Alarm System.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawing submission shall meet NFPA 20.
- .3 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for fire pump control and include product characteristics, performance criteria, physical size, finish and limitations.

- .4 Shop Drawings:
 - .1 Provide drawings for fire pump controller stamped and signed by professional engineer registered or licensed in Province of Nova Scotia, Canada. Shop drawings shall meet NFPA 20.
 - .2 Indicate:
 - .1 Method of anchorage
 - .2 Number of anchors.
 - .3 Supports.
 - .4 Reinforcement.
 - .5 Assembly details.
 - .6 Accessories.
 - .7 Indicate hydraulic and motor characteristics including Net Positive Suction Head (NPSH) required, make and model number.
 - .3 Provide power and control diagrams.
 - .4 Seismic requirements: as per NBCC and NFPA 20 and in accordance with Section 23 05 48.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit maintenance and engineering data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals in accordance with ANSI/NFPA 20.

1.5 MAINTENANCE MATERIALS SUBMITTALS

- .1 Extra Materials:
 - .1 Furnish spare parts for each pump in accordance with Section 01 78 10 - Closeout Submittals and as follows:
 - .1 One set of packing.
 - .2 One casing joint gasket.

1.6 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
 - .1 Test reports:
 - .1 Submit certified test reports for packaged fire pumps from approved independent testing laboratories, indicating compliance with specifications for specified performance characteristics and physical properties.
 - .2 Test each pump/driver package at factory to provide detailed performance data and to demonstrate compliance with NFPA and specification. Submit certified test curves for approval of Departmental Representative.
 - .3 Test hydrostatically to meet requirements of fire protection system to which it will be connected.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .1 Instructions: submit manufacturer's installation instructions.
 - .2 Manufacturer's Field Reports: manufacturer's field reports specified.
- .2 Qualifications:
 - .1 Installer: company or person specializing in packaged fire pump installations with documented experience and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding and packaging materials.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Select fire pump to satisfy fire protection system requirements and NFPA 20.
 - .2 Water supply:
 - .1 Available reservoir and wet pit water supply capacity of 42.5 m³ for Cell Pavilion
 - .2 Base design on NFPA 20 and hydraulic design calculations.
 - .3 Fire pump supplies:
 - .1 Wet pipe sprinkler system

2.2 FIRE PUMP: FP-1 & FP-2

- .1 Vertical turbine electric fire pump, listed by ULC.
- .2 Materials and construction: to NFPA 20.
 - .1 Discharge head: Class 30 cast iron with a separate cast iron foundation plate, and shall be furnished with a grease lubricated packing box and ANSI 125/150 lb. standard discharge flange.
 - .2 Pump column pipe shall be furnished in sections not exceeding 10 feet in length with straight threads and sleeve type couplings.
 - .3 Lineshaft: Open, water lubricated construction. Lineshaft shall be furnished in sections not exceeding 10 feet in length. Lineshaft shall be SAE 1045 steel of adequate size to transmit the horsepower and thrust required and shall have renewable shaft sleeves. The lineshaft shall run in neoprene bearings housed in bronze bearing retainers.
 - .4 Bowl Assembly: Class 30 cast iron with bronze bowl wearing rings, bronze enclosed impellers and steel impeller lock collects. The pump shaft shall be 416 stainless steel supported by bronze bowl bearings.
 - .5 Strainer: bronze basket strainer with a free area of at least 4 times the suction area and with openings to restrict the passage of a 1/2" sphere shall also be supplied.

- .6 The fire pump shall be driven by a vertical hollow shaft 1770 rpm, 3 phase 60Hz, 600 volt motor with non-reverse ratchet, P base, squirrel cage induction, NEMA design B. The motor shall mount directly on the pump discharge head assembly with a registered fit for correct shaft alignment. Enclosure shall meet NEMA weather protected type 1 design with stainless steel screens to prevent entrance of rodents. Motor shall have Class B or Class F insulation with temperature rise as specified by NEMA standards for class of insulation used and shall have a 1.15 service factor. The locked rotor current shall conform to Table 6-5.1.1 of NFPA-20. Motor will be UL listed for fire pump service.
- .7 Capacity: 15.8 l/s (250GPM) rated fire pump at 414kPa (60 PSI), 5 stage, designed to satisfy fire protection system requirements and NFPA.
- .3 Accessories to NFPA 20 requirements and in addition:
 - .1 Fire pump bypass fitted with shut off valves and check valves.
 - .2 Audible and visual suction side alarm.
 - .3 OS&Y valves on suction and shut off valves on discharge, electrically supervised.
 - .4 Main relief valve and open waste cone.
 - .5 Automatic air release.
 - .6 Flow meter and control valve.
 - .7 Circulation relief valve.
 - .8 Outside hose valve test header c/w hose connections.
- .4 Anchor bolts and templates:
 - .1 Supply for installation by others.
 - .2 Size anchor bolts to withstand seismic acceleration and velocity forces. In accordance with NFPA.

2.3 PRESSURE MAINTENANCE (JOCKEY) PUMP

- .1 General : multi stage pump, electrically driven, base mounted and assembled in a vertical shaft configuration with the suction and discharge connections being in-line at the bottom.
- .2 Capacity: designed to satisfy fire protection system requirements and NFPA.
- .3 Material: all hydraulic components and casing shall be manufactured from stainless steel AISI 304. Shaft made of stainless steel 316L shall be fitted with

tungsten carbide intermediary bearing. Mechanical seal suitable for full pressure and temperature range of the pump and fitted with carbon rotating face and silicon carbide stationary face.

- .4 Accessories: to NFPA 20.
- .5 Electrical: 575V, 3PH.
- .6 Jockey pump c/w cable lead. Provide extra length to splice cable to suit site condition.
- .7 Capacity: 3l/s at 483 kPA(70 PSI).

2.4 FIRE PUMP CONTROLLER

- .1 Fire pump controller: electric with automatic transfer switch, 600V 3PH. ULC listed, built to NFPA 20. NEMA 4X protection rating. Contains electrical readings, disconnecting means, identification, pressure readings, pressure and event recorder, pressure sensing, touch operator interface and all contacts as required to operate in conjunction with the fire alarm panel and required sequences of operation of the fire protection system. The controller shall be arranged to start the fire pump motor automatically on loss of system pressure with automatic stop and manual stop capabilities. Automatic stop can be disabled if required by authority having jurisdiction. An automatic weekly test timer shall also be standard.
- .2 Load shedding Contacts
- .3 Mounting: floor mounted.
- .4 Automatic duty/standby transfer: The controller shall be paired and automatically alternate from standby to duty mode in conjunction with the second fire pump controller. The alternation shall occur on a detection of fault in a particular system.

2.5 JOCKEY PUMP CONTROLLER

- .1 NFPA 20 and ULC listed, specifically designed to control jockey pumps.

- .2 Include an adjustable pressure switch and contactor or across the line starter to automatically start the jockey pump upon a drop of system pressure and automatically stop the pump after restoration of system pressure.
- .3 Provide "Power on" and "Pump run" pilot lights.
- .4 Mounting: wall mounted.
- .5 Electrical: 575V, 3PH.
- .6 Accessories to NFPA 20 requirements and in addition:
 - .1 Main disconnect
 - .2 Audible and visual indications.
- .7 NEMA 4X enclosure.

PART 3 EXECUTION

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install in accordance with ULC listing, NFPA 20, manufacturer's instructions and, approved shop drawings and Division 26.
- .2 Align pump and motor shafts to within manufacturer's recommended clearances prior to start-up.
- .3 Install wiring in accordance with manufacturer's instructions and applicable codes.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .2 Site Tests:
 - .1 Field test each fire pump, driver and controllers in accordance with NFPA 20. Testing to include:
 - .1 Verification of proper installation system initiation adjustment and fine tuning.
 - .2 Verification of the sequence of operations and alarm systems.
 - .2 Testing to be witnessed by Departmental Representative.
 - .3 The fire pump shall be hydraulically tested to twice the maximum pressure developed at shut-off but not less than 1724 kPa. Tests will meet or exceed NFPA 20 standard.
 - .1 The fire pump shall be subjected to a performance test or rated speed.
 - .2 The pump shall furnish not less than 150% of rated capacity at a pressure not less than 65% of rated head. The shut-off total head of the pump shall not exceed 140% of rated total head. Certified curves shall be supplied to the purchaser showing the efficiency, brake horsepower and total head developed at shut-off at rated capacity and at 150% of rated capacity.
 - .4 Develop detailed instructions for O & M installation.
 - .5 Performance Verification:
 - .1 Refer to commissioning plan.

3.4 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .2 Clean installed products in accordance to manufacturer's recommendation.
- .3 Waste Management: separate waste materials for reuse and recycling.

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for plumbing pumps.
- .2 Related Sections:
 - .1 Section 01 32 00 - Construction Progress Documentation.
 - .2 Section 01 33 00 - Submittal Procedures.
 - .3 Section 01 45 00 - Quality Control.
 - .4 Section 01 35 23 - Health and Safety.
 - .5 Section 01 78 10 - Closeout Submittals.
 - .6 Section 01 91 13 – General Commissioning (Cx) Requirements.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet for fixtures and equipment.
- .3 Shop Drawings.
 - .1 Submit shop drawings to indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries. Identify whether factory or field assembled.
 - .2 Wiring and schematic diagrams.
 - .3 Dimensions and recommended installation.
 - .4 Pump performance and efficiency curves.

- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .5 Instructions: submit manufacturer's installation instructions.
- .6 Manufacturers' Field Reports: manufacturers' field reports specified.
- .7 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals, include:
 - .1 Manufacturers name, type, model year, capacity and serial number.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list with names and addresses.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling.

PART 2 PRODUCTS

2.1 DOMESTIC HOT WATER RECIRCULATION PUMP (P-R1)

- .1 Capacity: as indicated.
- .2 Construction: closed-coupled, in-line centrifugal, all bronze construction, stainless steel shaft, stainless steel or bronze or bronze shaft sleeve, two oil lubricated bronze sleeves or ball bearings. design for 690 kPa and 105°C continuous service.
- .3 Motor: Drip-proof, with thermal overload protection.
- .4 Supports: provide as recommended by manufacturer.

.5 Acceptable Manufacturers:

- .1 Armstrong
- .2 Grundfos
- .3 Bell & Gossett

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 INSTALLATION

- .1 Make piping and electrical connections to pump and motor assembly and controls as indicated.
- .2 Ensure pump and motor assembly do not support piping.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests/Inspection:
 - .1 Check power supply.
 - .2 Check starter protective devices.
- .2 Start-up, check for proper and safe operation.
- .3 Check settings and operation of controls and operation of pumps.
- .4 Refer to commissioning plan

3.4 START-UP

- .1 General:
 - .1 In accordance with Section 01 91 13 - General Commissioning (CX) Requirements, supplemented as specified herein.
 - .2 Procedures:
 - .1 Check power supply.
 - .2 Check for safe and proper operation.
 - .3 Check settings, operation of operating, limit, safety controls, over-temperature, audible/visual alarms, other protective devices.
 - .4 Test operation of hands-on-auto switch.
 - .5 Adjust alignment of piping and conduit to ensure full flexibility.

3.5 REPORTS

- .1 In accordance with Section 01 91 13 - General Commissioning (CX) Requirements, supplemented as specified.
- .2 Include:
 - .1 PV results on approved PV Report Forms.
 - .2 Product Information report forms.
 - .3 Pump performance curves (family of curves) with final point of actual performance.

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for copper domestic water service used in the following:
 - .1 Copper incoming domestic water service, up to NPS 2 1/2.
 - .2 Hard drawn copper domestic hot and cold water services inside building.
 - .3 Soft copper tubing inside building.
 - .4 Tempered water service inside the building.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 10 - Closeout Submittals.
- .3 Section 01 91 13 – General Commissioning (Cx) Requirements.
- .4 Section 23 05 00 - Common Work Results for HVAC.
- .5 Section 23 05 05 - Installation of Pipework.
- .6 Section 23 05 23.01 - Valves - Bronze.
- .7 Section 23 05 23.02 Valves - Cast Iron: Gate, Globe, Check.
- .8 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .9 Section 33 11 16 - Incoming Site Water Utility Distribution Piping.

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME).
 - .1 ANSI/ASME B16.15-2013, Cast Bronze Threaded Fittings, Classes 125 and 250.
 - .2 ANSI/ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.

- .3 ANSI/ASME B16.22-01 (R2013), Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .4 ANSI/ASME B16.24-2011, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A 307-12, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM B 88M-13, Standard Specification for Seamless Copper Water Tube (Metric).
- .3 American Water Works Association (AWWA).
 - .1 AWWA C111-12, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- .4 Canadian Standards Association (CSA International).
 - .1 CSA B242-05(R2011), Groove and Shoulder Type Mechanical Pipe Couplings.
- .5 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).
- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .7 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).
 - .1 MSS-SP-67-11, Butterfly Valves.
 - .2 MSS-SP-70-11, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71-2011, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS-SP-80-2013, Bronze Gate, Globe, Angle and Check Valves.
- .8 National Research Council (NRC)/Institute for Research in Construction.
 - .1 NRCC 38728, National Plumbing Code of Canada (NPC) - 2010.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data for following: valves.

- .3 Provide maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.

1.5 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling.

PART 2 PRODUCTS

2.1 PIPING

- .1 Domestic hot, cold and recirculation systems, tempered water systems, within building.
 - .1 Above ground: copper tube, hard drawn, type L: to ASTM B 88M-05.
 - .2 Buried or embedded: copper tube, soft annealed, type K: to ASTM B 88M-09, in long lengths and with no buried joints.

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI/ASME B16.24- 2011.
- .2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15 -2013.
- .3 Cast copper, solder type: to ANSI/ASME B16.18-2012.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22-2013.
- .5 NPS 2 and larger: roll grooved to CSA B242.

2.3 JOINTS

- .1 Rubber gaskets, latex-free 1.6 mm thick: to ANSI/AWWA C111/A21.11-12.
- .2 Bolts, nuts, hex head and washers: to ASTM A 307-12, heavy series.
- .3 Solder: 95/5 tin copper alloy.
- .4 Teflon tape: for threaded joints.
- .5 Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket.
- .6 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F 492-95, complete with thermoplastic liner.

2.4 GATE VALVES

- .1 NPS 2 and under, soldered:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, screwed:
 - .1 Rising stem: to MSS-SP-80, Class 125, 860 kPa, bronze body, screw-in bonnet, solid wedge disc as specified Section 23 05 23.01 - Valves - Bronze.
- .3 NPS 2-1/2 and over, in mechanical room, flanged:
 - .1 Rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, OS&Y bronze trim specified Section 23 05 23.02 - Valves - Cast Iron.
- .4 NPS 2-1/2 and over, other than mechanical room, flanged:
 - .1 Non-rising stem: to MSS-SP-70, Class 125, 860 kPa, flat flange faces, cast-iron body, bronze trim, bolted bonnet specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check.
- .5 Acceptable material:
 - .1 Crane
 - .2 Jenkins
 - .3 Red White

2.5 GLOBE VALVES

- .1 NPS2 and under, soldered:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, renewable composition disc, screwed over bonnet as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Lockshield handles: as indicated.
- .2 NPS 2 and under, screwed:
 - .1 To MSS-SP-80, Class 150, 1 MPa, bronze body, screwed over bonnet, renewable composition disc as specified Section 23 05 23.01 - Valves - Bronze.
 - .2 Lockshield handles: as indicated.
- .3 Acceptable material:
 - .1 Crane
 - .2 Jenkins
 - .3 Red White

2.6 SWING CHECK VALVES

- .1 NPS 2 and under, soldered:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.
- .2 NPS 2 and under, screwed:
 - .1 To MSS-SP-80, Class 125, 860 kPa, bronze body, bronze swing disc, screw in cap, regrindable seat as specified Section 23 05 23.01 - Valves - Bronze.
- .3 NPS 2-1/2 and over, flanged:
 - .1 To MSS-SP-71, Class 125, 860 kPa, cast iron body, flat flange faces, regrind renewable seat, bronze disc, bolted cap specified Section 23 05 23.02 - Valves - Cast Iron: Gate, Globe, Check.
- .4 Acceptable material:
 - .1 Crane
 - .2 Jenkins
 - .3 Red White

2.7 BALL VALVES

- .1 NPS 2 and under, screwed:
 - .1 Class 150.
 - .2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE BunaN seat, steel lever handle as specified Section 23 05 23.01 - Valves - Bronze
- .2 NPS 2 and under, soldered:
 - .1 To ANSI/ASME B16.18, Class 150.
 - .2 Bronze body, stainless steel ball, PTFE adjustable packing, brass gland and PTFE BunaN seat, steel lever handle, with NPT to copper adaptors as specified Section 23 05 23.01 - Valves - Bronze.
- .3 Acceptable material:
 - .1 Crane
 - .2 Jenkins
 - .3 Red White

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with NPC Province(s) Plumbing Code and local authority having jurisdiction.
- .2 Install pipe work in accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified herein.
- .3 Assemble piping using fittings manufactured to ANSI standards.
- .4 Install DCW piping below and away from DCW and DHWR and other hot piping so as to maintain temperature of cold water as low as possible.
- .5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.
- .6 Buried tubing:
 - .1 Lay in well compacted washed sand in accordance with AWWA Class B bedding.

- .2 Bend tubing without crimping or constricting. Minimize use of fittings.

3.2 VALVES

- .1 Isolate equipment, fixtures and branches with ball valves.
- .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.3 PRESSURE TESTS

- .1 Conform to requirements of Section 23 05 00 - Common Work Results for HVAC.
- .2 Test pressure: greater of 1 times maximum system operating pressure or 860 kPa.
- .3 Pressure test report to be submitted to Departmental Representative and commissioning agent prior to installation of pipe insulation.

3.4 FLUSHING AND CLEANING

- .1 Flush entire system for 8 h. Ensure outlets flushed for 2 h. Let stand for 24 h, then draw one sample off longest run. Submit to testing laboratory to verify that system is clean to Provincial Federal potable water guidelines. Let system flush for additional 2 h, then draw off another sample for testing.

3.5 PRE-START-UP INSPECTIONS

- .1 Systems to be complete, prior to flushing, testing and start-up.
- .2 Verify that system can be completely drained.
- .3 Ensure that pressure booster systems are operating properly.
- .4 Ensure that air chambers, expansion compensators are installed properly.

3.6 DISINFECTION

- .1 Flush out, disinfect and rinse system to approval of Departmental Representative.
- .2 Coordinate with Section 33 11 16 - Site Water Utility Distribution Piping.
- .3 Upon completion, provide laboratory test reports on water quality for Departmental Representative's approval.

3.7 START-UP

- .1 Timing: Start up after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
- .2 Provide continuous supervision during start-up.
- .3 Start-up procedures:
 - .1 Establish circulation and ensure that air is eliminated.
 - .2 Check pressurization to ensure proper operation and to prevent water hammer, flashing and/or cavitation.
 - .3 Bring DHW storage tank up to design temperature slowly.
 - .4 Monitor piping DHW and DHWR piping systems for freedom of movement, pipe expansion as designed.
 - .5 Check control, limit, safety devices for normal and safe operation.
- .4 Rectify start-up deficiencies.

3.8 PERFORMANCE VERIFICATION

- .1 Timing:
 - .1 After pressure and leakage tests and disinfection completed, and certificate of completion has been issued by authority having jurisdiction.

.2 Procedures:

- .1 In accordance with Section 01 91 13 - General Commissioning (CX) Requirements.
- .2 Confirm water quality consistent with supply standards, verifying that no residuals remain as a result of flushing and/or cleaning.

.3 Reports:

- .1 In accordance with Section 01 91 13 - General Commissioning (CX) Requirements.
- .2 Include certificate of water flow and pressure tests conducted on incoming water service, demonstrating adequacy of flow and pressure.

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 The installation of drainage waste and vent piping.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM B 32-08, Specification for Solder Metal.
 - .2 ASTM B 306-13, Specification for Copper Drainage Tube (DWV).
 - .3 ASTM C 564-12, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .2 Canadian Standards Association (CSA International).
 - .1 CSA B67-1972(R1996), Lead Service Pipe, Waste Pipe, Traps, Bends and Accessories.
 - .2 CAN/CSA-B70-12, Cast Iron Soil Pipe, Fittings and Means of Joining.
 - .3 CAN/CSA-B125-01, Plumbing Fittings.

1.3 ACTION INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for insulation and adhesives, include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 23 - Health and Safety and 01 35 26 - Environmental Protection.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Provide maintenance data for incorporation into manual

PART 2 PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- .1 Above ground and vent Type DWV to: ASTM B 306.
 - .1 Fittings.
 - .1 Cast brass: to CAN/CSA-B125.
 - .2 Wrought copper: to CAN/CSA-B125.
 - .2 Solder: tin-lead, 50:50, type 50A.

2.2 CAST IRON PIPING AND FITTINGS

- .1 Buried sanitary, storm and vent, minimum NPS 3, to: CAN/CSA-B70, with one layer of protective coating of bituminous.
 - .1 Joints.
 - .1 Mechanical joints.
 - .1 Neoprene or butyl rubber compression gaskets: to ASTM C 564 or CAN/CSA-B70.
 - .2 Stainless steel clamps.
 - .2 Above ground sanitary, storm and vent: to CAN/CSA-B70.
 - .1 Joints.
 - .1 Mechanical Joints.
 - .1 Neoprene or butyl rubber compression gaskets with stainless steel clamps.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 In accordance with Section 23 05 05 - Installation of Pipework.
- .2 Install in accordance with Canadian Plumbing Code and local authority having jurisdiction.

3.2 APPLICATION

- .1 Use cast iron for all above grade storm drainage and for vertical sanitary drain risers.

3.3 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.

3.4 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessible and that access doors are correctly located.
 - .2 Open, cover with linseed oil and re-seal.
 - .3 Verify that cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage:
 - .1 Verify domes are secure.
 - .2 Ensure weirs are correctly sized and installed correctly.
 - .3 Verify provisions for movement of roof system.
- .4 Ensure that fixtures are properly anchored, connected to system and effectively vented.

- .5 Affix applicable label (storm, sanitary, vent, pump discharge etc.) c/w directional arrows every floor or 4.5 m (whichever is less).
- .6 Refer to commissioning plan.

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 The installation of drainage waste and venting piping-plastic.
 - .2 Related Sections:
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 01 35 23 - Health and Safety.
 - .3 Section 01 61 00 - Product Requirements.
 - .4 Section 23 05 05 - Installation of Pipe Work.

1.2 REFERENCES

- .1 ASTM International Inc.
 - .1 ASTM D 2235-04(R2011), Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
 - .2 ASTM D 2564-12, Standard Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-Series B1800-11, Thermoplastic Nonpressure Pipe Compendium - B1800 Series.
 - .2 CSA-B181.2-02, PVC Drain, Waste and Bent Pipe and Pipe Fittings.
 - .3 CSA-B182.1-02, Plastic Drain and sewer Pipe and Pipe Fittings.
- .3 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-36-00, Commercial Adhesives.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

- .2 Product Data:
 - .1 Provide manufacturer's printed product literature and datasheets for piping and adhesives, and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide two copies WHMIS MSDS - Material Safety Data Sheets in accordance with Section 01 35 23 - Health and Safety and Section 01 35 26 - Environmental Protection.

1.4 DELIVERY STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Store at temperatures and conditions recommended by manufacturer.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding and packaging materials.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Provide maintenance data for incorporation into manual

PART 2 PRODUCTS

2.1 MATERIAL

- .1 Adhesives and Sealants: in accordance with Section 07 92 00 - Joint Sealants.
 - .1 Maximum VOC limit 70 250 g/L to SCAQMD Rule 1168 GSES GS-36.

2.2 PIPING AND FITTINGS

- .1 For buried
 - .1 CAN/CSA B1800.
 - .2 CSA-B 181.2.
 - .3 CSA-B 182.1.
- .2 For all above ground piping - fire and smoke rated for use in a return air plenum.
 - .1 CAN.ULC S 102.2
 - .2 CSA-B181.2
 - .3 Flame spread rating not to exceed 25. Smoke developed classification not exceeding 50.

2.3 JOINTS

- .1 Solvent weld for PVC: to ASTM D 2564
- .2 Solvent weld for ABS: to ASTM D 2235.

PART 3 EXECUTION

3.1 APPLICATION

- .1 Manufacturer's Instructions: comply with manufacturer's written recommendations, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 In accordance with Section 23 05 05 - Installation of Pipework.
- .2 Install in accordance with National Plumbing Code and local authority having jurisdiction.

3.3 TESTING

- .1 Pressure test buried systems before backfilling.
- .2 Hydraulically test to verify grades and freedom from obstructions.
- .3 Testing to be in compliance with The National Plumbing Code of Canada 2010.

3.4 PERFORMANCE VERIFICATION

- .1 Cleanouts:
 - .1 Ensure accessible and that access doors are correctly located.
 - .2 Open, cover with linseed oil and re-seal.
 - .3 Verify cleanout rods can probe as far as the next cleanout, at least.
- .2 Test to ensure traps are fully and permanently primed.
- .3 Storm water drainage:
 - .1 Verify domes are secure.
 - .2 Ensure weirs are correctly sized and installed correctly.
 - .3 Verify provisions for movement of roof system.
- .4 Ensure fixtures are properly anchored, connected to system and effectively vented.
- .5 Affix applicable label (storm, sanitary, vent, pump discharge) c/w directional arrows every floor or 4.5 m (whichever is less).

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 23 05 19.01 - Thermometers and Pressure Gauges - Piping Systems.
- .2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA B51-09, Boiler, Pressure Vessel, and Pressure Piping Code.
 - .2 CAN/CSA-C22.2 No. 110.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings for review.
- .2 Indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 Closeout Submittals.
- .2 Provide maintenance and engineering data for incorporation into manual.

1.5 WARRANTY

- .1 For the Work of this Section 22 30 05 - Domestic Water Heaters, the 12 months warranty period is extended to number of years specified for each product.

PART 2 PRODUCTS

2.1 ELECTRIC WATER HEATERS

- .1 WH to CAN/CSA C22.2 No. 110, CAN/CSA-C191, with three immersion type elements 4500 W, 3 phase 208 V and surface mounted or immersion type adjustable thermostats.
- .2 Size 189 liter, 648 mm dia x 1.5 m high, glass-lined steel, heavy foam 50 mm insulation, enamelled steel jacket, 3 year warranty certificate.
- .3 Accessories and Trim:
 - .1 Complete with automatic adjustable temperature control with high temp safety cut-off, ASME rated p&T relief valve, 1" NPT pipe connections, hose drain connection and magnesium anode.
- .4 Acceptable Manufactures:
 - .1 AO Smith.
 - .2 Rheem.
 - .3 Giant.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's recommendations and authority having+ jurisdiction.
- .2 Provide insulation between tank and supports.
- .3 Install on concrete housekeeping pad.

3.2 FIELD QUALITY CONTROL

- .1 Manufacturer's factory trained, certified Engineer to start up and commission DHW heaters.
- .2 Refer to commissioning plan.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 23 - Health and Safety.
- .3 Section 01 78 10 - Closeout Submittals.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA B45 SERIES-02 (R2013), Plumbing Fixtures.
 - .2 CSA B125-01, Plumbing Fittings.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Indicate, for all fixtures and trim:
 - .1 Dimensions, construction details, roughing-in dimensions.
- .3 Closeout Submittals:
 - .1 Submit maintenance data in accordance with Section 01 78 10 - Closeout Procedures.
 - .2 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
 - .2 Details of operation, servicing, maintenance.
 - .3 List of recommended spare parts.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

- .1 Fixtures: manufacture in accordance with CSA B45S1-04 series.
- .2 Trim, fittings: manufacture in accordance with CSA B125-12.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Fixtures in any one location to be product of one manufacturer and of same type.
- .6 Trim in any one location to be product of one manufacturer and of same type.
- .7 SS-1 Room 102. Single Bowl Sink, cabinet mounted.
 - .1 18 gauge stainless steel with 18/10 chrome-nickel content, X pattern drain grooves, 15 mm radius grooves undermount installation. Bowl Dimensions: 381 mm X 381, 205 mm bowl depth. Overall dimensions: 431.8 mm X 431.8 mm X 205 mm.
 - .2 Waste Fitting: Rear position drain holes, 90 mm stainless steel strainers.
 - .3 Trim: Solid brass construction, ceramic disk cartridge for precise water flow/ temperature control, flexible braided stainless steel inlet hoses with 3/8" nut, single spray pattern. 0.14 l/s (2.2GPM) flow rate, spout swivels 160°, premium insulated brass pullout handspray
 - .4 Fixture piping: Hot and cold water supplies to fixture. chrome plated flexible supply pipes to each with screwdriver stop, reducers, escutcheon
 - .5 Acceptable Material:
 - .1 Blanco 401515
 - .2 Franke
 - .3 American Standard

- .6 Acceptable Trim
 - .1 Blanco 401085
 - .2 Franke
 - .3 American Standard

- .8 SS-2: Room 205. Single bowl sink, cabinet mounted.
 - .1 Single compartment 20 gauge type 302 stainless steel, counter mount sink c/w undercoating and waste fittings. Bowl Size: 457 mm X 406 mm X 203 mm deep. Overall dimensions: 511 mm X 460 mm X 203 mm.
 - .2 Trim: brass construction deck mounted single hole with side valve, 133 mm rigid / swing gooseneck spout, 8.3 L/min aerator, 70 mm lever handle, ceramic volume control and hot water limit stop cartridge, 9.5mm compression flexible stainless steel supply hoses.
 - .3 Waste Fitting: center back waste location, 90 mm crumb cup strainer and 38 mm brass tailpiece.
 - .4 Fixture piping: Hot and cold water supplies to fixture. chrome plated flexible supply pipes to each with screwdriver stop, reducers, escutcheon
 - .5 Acceptable Material:
 - .1 Franke
 - .2 American Standard
 - .3 Crane
 - .6 Acceptable Trim
 - .1 Chicago Faucets 2302-ABCP
 - .2 Franke
 - .3 American Standard

- .9 SS-3: Room 211, Single Bowl Sink, Barrier Free.
 - .1 From .9525mm thick 302 stainless steel, self rimming, counter mount sink with back ledge, 2 hole, 100mm centers, undercoated, mounting clamps. Overall dimensions: 392mm x 384mm x 152mm.
 - .2 Trim: Chrome plated, 100mm centreset, rigid swing gooseneck spout, vandal resistant, 1.9 LPM, non-aerating multi-laminar flow spray outlet. 100mm long wrist blade handle with vandal resistant screw.
 - .3 Waste Fitting: center waste location, 90mm crumb cup strainer and 38mm brass offset tailpiece, integral stainless steel basket strainer/stopper, tailpiece, cast brass, offset trap for barrier free installation.
 - .4 Fixture Piping: Hot and cold water supplies to each fixture. Chrome plated flexible supply pipes each with screwdriver stop, reducers, escutcheon.
 - .5 Acceptable Material:

- .1 Franke LBS1306-1/2
- .2 American Standard
- .3 Crane
- .6 Trim (Room 211):
 - .1 Chrome plated, 100 mm centreset, 200 mm center L type swing spout, 2.2 LPM aerator. 50 mm metal canopy single wing handles.
 - .2 Acceptable Material:
 - .1 Chicago Faucets 1895-L8ABCP
 - .2 Delta
 - .3 American standard
- .10 SS-4 Room 118. Single bowl sink, cabinet mounted.
 - .1 Single compartment 20 gauge type 302 stainless steel, counter mount sink c/w undercoating and waste fittings. Bowl Size: 584 mm X 432 mm X 203 mm deep. Overall dimensions: 641 mm X 489 mm X 203 mm.
 - .2 Trim: brass construction deck mounted single hole with side valve, 133 mm rigid / swing gooseneck spout, 8.3 L/min aerator, 70 mm lever handle, ceramic volume control and hot water limit stop cartridge, 9.5mm compression flexible stainless steel supply hoses.
 - .3 Waste Fitting: center back waste location, 90 mm crumb cup strainer and 38 mm brass tailpiece.
 - .4 Fixture piping: Hot and cold water supplies to fixture. chrome plated flexible supply pipes to each with screwdriver stop, reducers, escutcheon
 - .5 Acceptable Material:
 - .1 Franke S7308-1
 - .2 American Standard
 - .3 Crane
 - .6 Acceptable Trim
 - .1 Chicago Faucets 2302-ABCP
 - .2 Franke
 - .3 American Standard
 - .1
- .11 MS-1: Rooms 123, 208
 - .1 Sink, moulded stone, 300mm high undrilled integral back. Size: 610mm x 610mm x 254mm. Stainless steel drain with strainer. Splash guard: 600mm height, 20ga stainless steel (all adjacent walls).
 - .2 Supply fitting: integral atmospheric vacuum breaker, chrome plated, 203mm centreset, unrestricted hose end outlet, brace to wall, lever

handles with vandal resistant screw, escutcheons, union inlets, heavy brass spout.

.3 Acceptable Material:

.1 Fiat Modesto, MSB Series

.2 American Standard

.12 EW-1: Room 203 Eye/Face Wash

.1 Wall hung, stainless steel bowl, single inverted directional laminar flow head with integral flow control, chrome plated brass stay open ball valve with stainless steel ball and stem – inline mesh water strainer. Flow rate 24 LPM, 32mm waste, universal sign. Foot operated auto-reset no chain.

.2 Waste: chrome plated trap, heavy cast brass adjustable body with slip nut, with cleanout.

.3 Mixing Valve: modular brass design with one piece casting, 13mm outlet, 26 deg.C factor setting. 14.4 LPM bypass flow rate.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Mounting heights:

.1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.

.2 Wall-hung fixtures: as indicated, measured from finished floor.

.3 Coordinate with architectural details and elevation.

3.2 ADJUSTING

.1 Conform to water conservation requirements specified this section.

.2 Adjustments:

.1 Adjust water flow rate to design flow rates.

.2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.

- .3 Checks:
 - .1 Aerators: operation, cleanliness.
 - .2 Vacuum breakers, backflow preventers: operation under all conditions.
- .4 Thermostatic controls:
 - .1 Verify temperature settings, operation of control, limit and safety controls.

3.3 FIELD QUALITY CONTROL

- .1 Performance verification:
 - .1 Refer to commissioning plan.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 91 13 - General Commissioning (Cx) Requirements.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 126-04(2014), Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - .2 ASTM B 62-09, Specification for Composition Bronze or Ounce Metal Castings.
- .2 Canadian Standards Association (CSA)
 - .1 CSA B64-Series-11, Backflow Preventers and Vacuum Breakers.
 - .2 CSA B79-08, Floor, Area and Shower Drains, and Cleanouts for Residential Construction.
 - .3 CAN/CSA-B356-10(R2010), Water Pressure Reducing Valves for Domestic Water Supply Systems.
- .3 Plumbing and Drainage Institute (PDI)
 - .1 PDI-G101-2010, Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data.
 - .2 PDI-WH201-2010, Water Hammer Arresters Standard.

1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 For product data, indicate dimensions, construction details and materials for items specified herein.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.
- .2 Data to include:
 - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

PART 2 PRODUCTS

2.1 FLOOR DRAINS

- .1 Floor drains: to CSA B79-08.
- .2 FD-1: general duty; epoxy coated, cast iron body round, anchor flange, adjustable head, 150 mm nickel bronze strainer, integral seepage pan and water membrane flange and trap primer connection.
 - .1 Acceptable material:
 - .1 Watts FD-100-C-A
 - .2 Zurn
 - .3 J.R. Smith
- .3 FD-2: Install in rooms 212, 211, 210, 209, 207, 208, 206. 127mm Type B Strainer, 76mm pipe outlet, vandal proof screws with using Loctite liquid thread lockers, Series 262, Milspec S-46163A Type 2, Grade O, 71000-P deep seal trap with trap primer connection. Maximum 12mm openings, flush mounted.
 - .1 Acceptable Material:
 - .1 Zurn ZN-415-B5-VP
- .4 FFD-1: combination funnel floor drain, 200 mm; cast iron body with integral seepage pan, clamping collar, nickel-bronze adjustable head strainer with integral oval funnel and trap primer connection.

- .1 Acceptable material:
 - .1 Watts FD-100-EG
 - .2 Zurn
 - .3 J.R. Smith

2.2 ELECTRONIC TRAP SEAL PRIMERS

- .1 Built-in 120 to 24 volt transformer and fuse.
- .2 LED indication of operation and power.
- .3 Manual override and testing push button.
- .4 Permanently programmed electronic timer.
- .5 Normally-closed 24 VAC slow closing solenoid valve with integral strainer.
- .6 Air gap fitting for backflow prevention.
- .7 Copper water inlet and manifold with PEX and copper outlets. Quantity to suit application.
- .8 Minimum pressure 20.7 kPa, working pressure 2.5 to 690 kPa.
- .9 Galvanized steel surface mounting box.
- .10 Acceptable material:
 - .1 Zurn
 - .2 Mifab
 - .3 PPP

2.3 CLEANOUTS

- .1 Cleanout Plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket, adjustable housing, cover, membrane flange and clamping collar.

- .2 Access Covers:
 - .1 Wall Access: face or wall type, stainless steel round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
 - .2 Floor Access: round cast iron body and frame with adjustable secured nickel bronze top and:
 - .1 Plugs: bolted bronze with neoprene gasket.
 - .2 Cover for Unfinished Concrete Floors: nickel bronze round, gasket, vandal-proof screws.
 - .3 Cover for tile and linoleum floors: polished nickel bronze with recessed cover for linoleum or tile infill, complete with vandal-proof locking screws.
 - .4 Cover for carpeted floors: polished nickel bronze with deep flange cover for carpet infill, complete with carpet retainer vandal-proof locking screws.

2.4 BACK FLOW PREVENTER DOUBLE-CHECK TYPE

- .1 Preventers: to CSA B-64-11 Series, double check assembly type, consisting of two spring-loaded check valves and two OS&Y gate valves for shutoff, and a strainer on the assembly inlet.
- .2 Body: epoxy coated cast iron.
- .3 Seats: bronze.
- .4 Trim: stainless steel.
- .5 Maximum working temperature and pressure: 1220 kPa at 43°C.
- .6 Acceptable Material:
 - .1 Watts
 - .2 Wilkins
 - .3 Febco

2.5 BACK FLOW PREVENTERS-REDUCED PRESSURE PRINCIPAL TYPE

- .1 Preventers: to CSA B64-Series-01 Series, reduced pressure principal assembly type consisting of two spring-loaded check valves with intermediate relief valve assembly, two OS&Y gate valves for shut-off, and a strainer on the assembly inlet.
- .2 Body: Epoxy coated cast iron.
- .3 Seals: Bronze
- .4 Trim: stainless steel
- .5 Test cocks: bronze
- .6 Discs: rubber
- .7 Relief valves: bronze
- .8 Maximum working temperature and pressure: 1220 kPa at 60°C.
- .9 Acceptable Material:
 - .1 Watts
 - .2 Wilkins
 - .3 Febco

2.6 VACUUM BREAKERS

- .1 Breakers: to CSA B64-Series-01 Series, vacuum breaker atmospheric type.
- .2 Acceptable Material:
 - .1 Watts
 - .2 J.R. Smith
 - .3 Zurn

2.7 PRESSURE REGULATORS

- .1 Up to NPS 1-1/2 bronze bodies, screwed: to ASTM B62-09.
- .2 NPS2 and over, semi-steel bodies, Class 125, flanged: to ASTM A 126-04(2009), Class B.
- .3 Semi-steel spring chambers with bronze trim.
- .4 Acceptable Material:
 - .1 Watts
 - .2 Fisher
 - .3 Wilkins

2.8 HOSE BIBS AND SEDIMENT FAUCETS

- .1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.
- .2 Acceptable Material:
 - .1 Cambridge
 - .2 Emco
 - .3 Febco

2.9 STRAINERS

- .1 860 kPa, Y type with 20 mesh, monel, bronze or stainless steel removable screen.
- .2 NPS 2 and under, bronze body, screwed ends, with brass cap.
- .3 NPS 2 1/2 and over, cast iron body, flanged ends, with bolted cap.
- .4 Acceptable material:
 - .1 Watts
 - .2 Zurn

.3 Wilkins

2.10 NON FREEZE WALL HYDRANT

.1 Recessed bronze box with door and key containing integral vacuum breaker, NPS 3/4" hose outlet removable operating key.

2.11 ROOF DRAINS

.1 Type RD

.1 Standard roof drain with cast iron body with (aluminum) dome, under-deck clamp to suit roof construction, flashing clamp ring with integral gravel stop.

.2 Acceptable material:

.1 Zurn

.2 Mifab

.3 Ancon

2.12 EXPANSION TANK (XT-1)

.1 Vertical welded steel tank to ASME section VIII for potable water application.

.2 Maximum total Tank Volume: as indicated.

.3 Operating Range: to suit 274 kPa / 414 kPa systems. Acceptance factor 0.268 minimum. Usable drawdown volume: as indicated.

.4 Integral replaceable elastomer bladder, FDA approved, suitable for use with potable water.

.5 Accessories:

.1 Valved system connection. sizes as indicated, bronze connections or stainless steel.

.2 32 mm nominal tee drain cock

- .3 115 mm nominal dia. 0-800 kPa pressure gauge.
- .4 Air valve.
- .5 Necessary tapping.
- .6 Acceptable Material:
 - .1 Armstrong
 - .2 Pentair
 - .3 ITT

2.13 EXPANSION TANK (XT-2)

- .1 Drawn-steel tank with powder coated interior lining to ASME section VIII for potable hot water application.
- .2 Maximum total Tank Volume: as indicated.
- .3 Operating Range: to suit 274 kPa/414 kPa systems. Usuable drawdown volume: as indicated.
- .4 Butyl rubber parabolic diaphragm, suitable for use with potable water.
- .5 Accessories:
 - .1 Valved system connection. sizes as indicated, bronze connections or stainless steel
 - .2 32 mm nominal tee drain cock
 - .3 115 mm nominal dia. 0-800 kPa pressure gauge.
 - .4 Air valve.
 - .5 Necessary tapping.
- .6 Acceptable Material:
 - .1 AO Smith
 - .2 Rheem
 - .3 Giant

2.14 WATER ARRESTORS

- .1 Pre-charged type to PDI WH201.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions and data sheet.

3.2 INSTALLATION

- .1 Install in accordance with Canadian Plumbing Code, and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.3 CLEANOUTS

- .1 Install cleanouts at base of rainwater leaders, at locations required by code, and indicated.
- .2 Bring cleanouts to wall or finished floor in finished areas.
- .3 Building drain cleanout: line size to maximum NPS 4.

3.4 FLOOR DRAINS

- .1 Install where indicated, and in accordance with manufacturer's instructions.

3.5 WATER HAMMER ARRESTORS

- .1 Install on branch supplies to fixtures or group of fixtures.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.6 TRAP SEAL PRIMERS

- .1 Install for all floor drains.
- .2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Department Representative.
- .3 Install soft copper tubing to floor drain.
- .4 Install electronic trap primer for floor drains in mechanical rooms and remote locations not near plumbing fixtures.

3.7 BACKFLOW PREVENTORS

- .1 Install in accordance with CSA B64-Series-14, where indicated and elsewhere as required by code.
- .2 Pipe relief part discharge to drain with appropriate air gap fitting.

3.8 STRAINERS

- .1 Install with sufficient room to remove basket.

3.9 HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Install at bottom of all risers, at low points to drain systems, and as indicated.

3.10 WATER MAKE-UP ASSEMBLY

- .1 Install on valved bypass.
- .2 Pipe discharge from relief valve to nearest floor drain.

3.11 START-UP

- .1 General:
 - .1 In accordance with Section 01 91 13 - General Commissioning (CX) Requirements, supplemented as specified herein.
- .2 Timing: Start-up only after:
 - .1 Pressure tests have been completed.
 - .2 Disinfection procedures have been completed.
 - .3 Certificate of static completion has been issued.
 - .4 Water treatment systems operational.
- .3 Provide continuous supervision during start-up.

3.12 TESTING AND ADJUSTING

- .1 General:
 - .1 In accordance with Section 01 91 13 - General Commissioning (CX) Requirements, supplemented as specified herein.
- .2 Timing:
 - .1 After start-up deficiencies rectified.
 - .2 After certificate of completion has been issued by authority having jurisdiction.
- .3 Adjustments:
 - .1 Verify that flow rate and pressure meet design criteria.

- .2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.
- .4 Floor drains:
 - .1 Verify operation of trap seal primer.
 - .2 Prime, using trap primer. Adjust flow rate to suit site conditions.
 - .3 Check operations of flushing features.
 - .4 Check security, accessibility, removability of strainer.
 - .5 Clean out baskets.
 - .6 Report will be submitted stating a trap seal primer has been checked.
- .5 Access doors:
 - .1 Verify size and location relative to items to be accessed.
- .6 Water hammer arrestors:
 - .1 Verify proper installation of correct type of water hammer arrestor.
- .7 Commissioning Reports:
 - .1 In accordance with Section 01 91 13 - General Commissioning (CX) Requirements, supplemented as specified herein.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 23 - Health and Safety.
- .3 Section 01 78 10 - Closeout Submittals.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA-B45 Series-04, Plumbing Fixtures.
 - .2 CAN/CSA-B125-12, Plumbing Fittings.
 - .3 CAN/CSA-B651-12, Barrier-Free Design.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Indicate fixtures and trim:
- .4 Dimensions, construction details, roughing-in dimensions.
- .5 Factory-set water consumption per flush at recommended pressure.
- .6 (For water closets, urinals): minimum pressure required for flushing.
- .7 Closeout Submittals:
 - .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 01 78 10 - Closeout Submittals.
 - .2 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.

- .2 Details of operation, servicing, maintenance.
- .3 List of recommended spare parts.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 PRODUCTS Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Fixtures in any one location to be product of one manufacturer and of same type.
- .6 Trim in any one location to be product of one manufacturer and of same type.
- .7 Fixture piping:
 - .1 Hot and cold water supplies to fixtures:
 - .1 Chrome plated flexible supply pipes with screwdriver stop, reducers, escutcheon.
 - .2 Waste:
 - .1 Brass P trap with clean out on fixtures not having integral trap.
 - .2 Chrome plated in exposed places.
- .8 Chair carriers:
 - .1 Provide factory manufactured floor-mounted carrier systems for wall-mounted fixtures.
 - .2 Carriers shall be adjustable, epoxy coated cast iron fitting, with ductile iron foot supports, 100mm no hub waste, and 50mm no hub vent. Back to

back carriers to be used where two water closets are installed back to back.

2.2 WATER CLOSETS

.1 WC-1: Room 206 Water Closet

- .1 Floor mounted, tank type, vitrous china, everclean antimicrobial surface, raised sanitary bar and four points tank stabilization, two piece, lined tank, oversize flush valve with flapper, metal shank fill valve, floor outlet, bolt caps. Water consumption: 6L per flush. Tank with tamperproof locking device.
- .2 Seat: heavy duty for elongated bowl, open front, white solid plastic, less cover, reinforced stainless steel check hinges
- .3 Toilet supply: chrome plated polished brass, commercial duty ¼ turn ball valve angle stops, escutcheons, flexible copper riser
- .4 Floor flange: same material as connecting pipe, brass bolts, rubber gasket
- .5 Acceptable Material:
 - .1 American Standard Cadet Pro 215CA.054.
 - .2 Crane.
 - .3 Zurn.

.2 WC-2: Rooms 103, 108. 117 Water closet, barrier free

- .1 Floor mounted, tank type, vitrous china, everclean antimicrobial surface, raised sanitary bar and four points tank stabilization, two piece, lined tank, oversize flush valve with flapper, metal shank fill valve, floor outlet, bolt caps. Water consumption: 6L per flush. Tank with tamperproof locking device.
- .2 Seat: heavy duty for elongated bowl, open front, white solid plastic, with cover, reinforced stainless steel check hinges
- .3 Toilet supply: chrome plated polished brass, commercial duty ¼ turn ball valve angle stops, escutcheons, flexible copper riser
- .4 Floor flange: same material as connecting pipe, brass bolts, rubber gasket
- .5 Acceptable Material:
 - .1 American Standard Cadet Pro Right Height 215AA.004
 - .2 Crane

2.3 WASHROOM LAVATORIES

- .1 LAV-1: Room 117 Oval Countertop sink, Barrier Free.
 - .1 Vitreous china, everclean surface, self rimming, front overflow. 100mm centers, white. Mounting clamps. Overall dimensions: 419mm x 279mm x 143mm. 100mm centers.
 - .2 Trim: Electronic faucet, chrome plated, 100mm centers, cast brass, 1.9 LPM, aerator spray outlet, infrared sensor with screw adjustable range, filtered solenoid valve with serviceable strainer, module control assembly with splashproof junction box and mounting kit. 24VAC 50/60Hz vandal proof box. Provide tee adaptors and flex pipe. Plug in 120 V. Install as per Division 26.
 - .3 Mixing Valve: Point of use, bronze body, temperature adjusting dial, 10mm compression fittings, high temperature thermostatic limit stop, automatic reset, integral checks. Temperature capability to 38 deg C.
 - .4 Fixture Piping: Hot and cold water supplies to mixing valve in ceiling space. Chrome plated flexible tempered supply pipe with screwdriver stop, reducers, escutcheon.
 - .5 Waste Fitting: Open grid drain, chrome plated cast brass one piece top, 32mm tailpiece. offset trap for barrier free.
 - .6 Acceptable Material:
 - .1 American Standard 0954.0004EC/0059.020EC
 - .2 Crane
 - .3 Franke
 - .7 Acceptable Trim Material:
 - .1 Sloan ETF-600-LT
 - .2 Chicago Faucets
 - .3 American Standards
- .2 LAV-2: Rooms 103, 108 Wall hung Basin Barrier free
 - .1 Vitreous china, rear overflow, recessed self-draining faucet ledge, for carrier with concealed arms, semi-pedestal p-trap cover. Overall dimensions: 540mm x 520mm x 165mm. 100mm centers. Mounting clamps.
 - .2 Trim: Electronic faucet, chrome plated, 100mm centers, cast brass, 1.9 LPM, aerator spray outlet, infrared sensor with screw adjustable range, filtered solenoid valve with serviceable strainer, module control assembly with splashproof junction box and mounting kit. 24VAC 50/60Hz vandal proof box. Provide tee adaptors and flex pipe. Plug in 120 V. Install as per Division 26.

- .3 Mixing Valve: Point of use, bronze body, temperature adjusting dial, 10mm compression fittings, high temperature thermostatic limit stop, automatic reset, integral checks. Temperature capability to 38 deg C.
- .4 Fixture Piping: Hot and cold water supplies to each fixture. Chrome plated flexible supply pipes each with screwdriver stop, reducers, escutcheon.
- .5 Waste Fitting: Open grid drain, chrome plated cast brass one piece top, 32mm tailpiece. offset trap for barrier free.
- .6 Fixture Carrier: concealed arms, wall flanges secured in wall with locking device and leveling screws.
- .7 Acceptable Material:
 - .1 American Standard Cadet 9494.001.
 - .2 Crane
 - .3 Franke
- .8 Acceptable Trim Material:
 - .1 Sloan ETF-600-LT
 - .2 Chicago Faucets
 - .3 American Standards
- .3 LAV-3: Room 206 Wall hung basin
 - .1 Vitreous china, rear overflow, faucet ledge, for carrier "U" bracket. 100mm centers. Overall dimensions: 622mm x 508mm x 203mm. Mounting clamps.
 - .2 Trim: Electronic faucet, chrome plated, 100mm centers, cast brass, 1.9 LPM, aerator spray outlet, infrared sensor with screw adjustable range, filtered solenoid valve with serviceable strainer, module control assembly with splashproof junction box and mounting kit. 24VAC 50/60Hz vandal proof box. Provide tee adaptors and flex pipe. Plug in 120 V. Install as per Division 26.
 - .3 Mixing Valve: Point of use, bronze body, temperature adjusting dial, 10mm compression fittings, high temperature thermostatic limit stop, automatic reset, integral checks. Temperature capability to 38 deg C.
 - .4 Fixture Piping: Hot and cold water supplies to each fixture. Chrome plated flexible supply pipes each with screwdriver stop, reducers, escutcheon.
 - .5 Waste Fitting: Open grid drain, chrome plated cast brass one piece top, 32mm tailpiece.
 - .6 Fixture Carrier: concealed arms, wall flanges secured in wall with locking device and leveling screws.

- .7 Acceptable Material:
 - .1 American Standard 0236.004
 - .2 Crane
 - .3 Franke
- .8 Acceptable Trim Material:
 - .1 Sloan ETF-600-LT
 - .2 Chicago Faucets
 - .3 American Standards
- .4 LAV-4/5: Rooms 209, 210 Suicide Resistant Combi, Combination Lavatory/Toilet Fixture
 - .1 No paper holders on combi units, serviced from accessible pipe chase, 14ga type 304 stainless steel, satin finish. Sound deadened with fire-resistant material, wall sleeve. Waste outlet: 38mm plain end. Air control pneumatically operated, push button valve. Direct acting, non-metering type. Elongated toilet bowl. Waste outlet 60mm plain end. BPH hemispherical penal bubbler, PBH hemispherical penal pushbutton. Units angled left or right (requires site verification). Mount on-floor wall outlet. Single temp. Mechanical flush valve (Flush Valve mounted on toilet side). Fixture mounted trim,
 - .2 Acceptable Material:
 - .1 Acorn Penal-Ware 1440 Series
 - .2 Willoughby ECW-1806-R/L-MOD
 - .3 Mixing Valve: Point of use, bronze body, temperature adjusting dial, 10mm compression fittings, high temperature thermostatic limit stop, automatic reset, integral checks. Temperature capability to 38 deg C.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Mounting heights:
 - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.
 - .2 Wall-hung fixtures: as indicated.
 - .3 Barrier Free: to comply with most stringent of either NBCC or CAN/CSA B651, or DND accessibility guide.

3.2 ADJUSTING

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates.
 - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
 - .3 Adjust flush valves to suit actual site conditions.
 - .4 Adjust urinal flush timing mechanisms.
- .3 Checks:
 - .1 Water closets, urinals: flushing action.
 - .2 Aerators: operation, cleanliness.
 - .3 Vacuum breakers, backflow preventers: operation under all conditions.

3.3 FIELD QUALITY CONTROL

- .1 Performance verification:
 - .1 Refer to commissioning plan.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 23 - Health and Safety.
- .3 Section 01 78 10 - Closeout Procedures.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA B45 SERIES-02 (R2008), Plumbing Fixtures.
 - .2 CSA B125-01, Plumbing Fittings.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate, for all fixtures and trim:
 - .1 Dimensions, construction details, roughing-in dimensions.
- .3 Closeout Submittals:
 - .1 Provide maintenance data including monitoring requirements for incorporation into manuals specified in Section 01 78 10 - Closeout Submittals.
 - .2 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
 - .2 Details of operation, servicing, maintenance.
 - .3 List of recommended spare parts.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.
- .2 Delivery materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding and packaging materials.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

- .1 Fixtures: manufacture in accordance with CSA B45 Series-12.
- .2 Trim, fittings: manufacture in accordance with CSA B125.3-12.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: architectural drawings to govern.
- .5 Fixtures in any one location to be product of one manufacturer and of same type.
- .6 Trim in any one location to be product of one manufacturer and of same type.
- .7 SH-1: Room 117 Shower:
 - .1 Shower Valve: pressure balancing, washerless ceramic drip free disc valve cartridge, solid brass body, integral stops. Metal wall escutcheons.
 - .2 Handshower: Commercial slide bar, 610mm, 9.5 LPM, maximum flow rate, spray head, 1500mm flexible metal hose, wall supply elbow with flange, inline vacuum breaker.
 - .3 Acceptable Material:

- .1 Stern Williams 1900-VOCCP
- .2 Delta
- .3 American Standard
- .4 Acceptable Handshower Material:
 - .1 Stern Williams 151-VB-WS
 - .2 Delta
 - .3 American Standard
- .8 SH-2: Room 207 Shower
 - .1 Single button, "no" soap holder, front access, 14Ga type 304 stainless steel with satin finish, chrome plated shower head, vandal resistant, pneumatically operated valve, atmospheric air, non-metering. Provide necessary fasteners.
 - .2 Acceptable Material:
 - .1 Penal Ware 1741FA Series
 - .3 Mixing Valve: Point of use, bronze body, temperature adjusting dial, 10mm compression fittings, high temperature thermostatic limit stop, automatic reset, integral checks. Temperature capability to 38 deg.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Mounting heights:
 - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified.

3.2 ADJUSTING

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments:
 - .1 Adjust water flow rate to design flow rates.
 - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
- .3 Checks:
 - .1 Aerators: operation, cleanliness.

- .2 Vacuum breakers, backflow preventers: operation under all conditions.
- .4 Thermostatic controls:
 - .1 Verify temperature settings, operation of control, limit and safety controls.

3.3 FIELD QUALITY CONTROL

- .1 Performance verification:
 - .1 Refer to commissioning plan.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings; submit drawings stamped and signed by professional engineer registered or licensed in Province of Nova Scotia, Canada when requested.
- .3 Shop drawings to show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances.
- .4 Shop drawings and product data accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify current model production.
 - .5 Certification of compliance to applicable codes.
- .5 In addition to transmittal letter referred to in Section 01 33 00 - Submittal Procedures: use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.
- .6 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.
 - .2 Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
 - .3 Operation data to include:
 - .1 Control schematics for systems including environmental controls.
 - .2 Description of systems and their controls.
 - .3 Description of operation of systems at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for systems and component.

- .5 Description of actions to be taken in event of equipment failure.
- .6 Valves schedule and flow diagram.
- .7 Colour coding chart.
- .4 Maintenance data to include:
 - .1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .5 Performance data to include:
 - .1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified.
 - .4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .6 Approvals:
 - .1 Submit 3 copies of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
 - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .7 Additional data:
 - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
 - .1 Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection.
- .9 As-built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.

- .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
- .3 Submit to Departmental Representative for approval and make corrections as directed.
- .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
- .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

1.3 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.
- .3 All work to comply with SOR/2003-289; "Federal Halocarbon Regulations 2003".

1.4 MAINTENANCE

- .1 Furnish spare parts in as follows:
 - .1 One set of packing for each pump.
 - .2 One casing joint gasket for each size pump.
 - .3 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 EXECUTION

3.1 PAINTING REPAIRS AND RESTORATION

- .1 Do painting in accordance with Section 09 91 00 - Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

3.2 CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
- .2 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
- .3 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .4 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.4 DEMONSTRATION

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

3.5 PROTECTION

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

PART 1 GENERAL

1.1 USE OF SYSTEMS

- .1 Use of new permanent heating and ventilating systems for supplying temporary heat or ventilation is permitted at discretion of department representative. Contractor is responsible for damage to heating and or ventilation system if use is permitted.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not used.

PART 1 GENERAL

1.1 RELATED SECTION

- .1 Section 01 74 00 – Cleaning and Waste Processing.
- .2 Section 07 84 00 - Firestopping.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 EXECUTION

3.1 CONNECTIONS TO EQUIPMENT

- .1 In accordance with manufacturer's instructions unless otherwise indicated.
- .2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.
- .3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.2 CLEARANCES

- .1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer, as well as applicable local codes and standards.
- .2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, components.

3.3 DRAINS

- .1 Install piping with grade in direction of flow except as indicated.
- .2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.
- .3 Pipe each drain valve discharge separately to above floor drain. Discharge to be visible.
- .4 Drain valves: NPS 3/4 ball valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 AIR VENTS

- .1 Install automatic air vents at high points in piping systems.
- .2 Install isolating valve at each automatic air valve.
- .3 Install drain piping to approved location and terminate where discharge is visible.

3.5 DIELECTRIC COUPLINGS

- .1 General: Compatible with system, to suit pressure rating of system.
- .2 Locations: Where dissimilar metals are joined.
- .3 NPS 2 and under: isolating unions or bronze valves.
- .4 Over NPS 2: Isolating flanges.

3.6 PIPEWORK INSTALLATION

- .1 Screwed fittings jointed with Teflon tape.
- .2 Protect openings against entry of foreign material.
- .3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.
- .4 Assemble piping using fittings manufactured to ANSI standards.
- .5 Saddle type branch fittings may not be used
- .6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.
- .7 Install concealed pipework to minimize furring space, maximize headroom, conserve space.
- .8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.
- .9 Install, except where indicated, to permit separate thermal insulation of each pipe.
- .10 Group piping wherever possible and as indicated.
- .11 Ream pipes, remove scale and other foreign material before assembly.
- .12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.
- .13 Provide for thermal expansion as required and as indicated.
- .14 Valves:
 - .1 Install in accessible locations.
 - .2 Remove interior parts before soldering.
 - .3 Install with stems above horizontal position unless otherwise indicated.
 - .4 Valves accessible for maintenance without removing adjacent piping.
 - .5 Install globe valves in bypass around control valves.
 - .6 Use butterfly or ball valves at branch take-offs for isolating purposes except where otherwise specified.
 - .7 Install butterfly valves between weld neck flanges to ensure full compression of liner.

- .8 Use chain operators on gate and globe valves NPS 2-1/2 and larger where installed more than 2400 mm above floor in Mechanical Rooms.
- .15 Check Valves:
 - .1 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

3.7 SLEEVES

- .1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies (except drywall assemblies), and elsewhere as indicated.
- .2 Material: Schedule 40 black steel pipe.
- .3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.
- .4 Sizes: 6 mm minimum clearance between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Installation:
 - .1 Concrete, masonry walls, concrete floors on grade: Terminate flush with finished surface.
 - .2 Other floors: Terminate 25 mm above finished floor.
 - .3 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181-99.
- .6 Sealing:
 - .1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.
 - .2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.
 - .3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.
 - .4 Ensure no contact between copper pipe or tube and sleeve.

3.8 ESCUTCHEONS

- .1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.
- .2 Construction: One piece type with set screws. Chrome or nickel plated brass or type 302 stainless steel.
- .3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.9 PREPARATION FOR FIRESTOPPING

- .1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation to Section 07 84 00 - Firestopping.
- .2 Uninsulated unheated pipes not subject to movement: No special preparation.
- .3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.
- .4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.10 FIRESTOPPING DEVICES FOR PLASTIC PIPES

- .1 Combustible pipe penetrations: the plastic pipes shall be sealed at the penetration by a firestop system that has an "F" rating of not less than the fire resistance rating required for the fire separation when subjected to the fire list method in CAN 4-S115-M, "Standard Method of Fire Tests of Firestop Systems", with a pressure differential of 50 Pa between the exposed and unexposed sides, with higher pressure on the exposed side.
- .2 Provide fire stopping at the following locations:
 - .1 All horizontal penetrations through masonry wall construction.
- .3 Acceptable material:
 - .1 3M Firestop devices for PVC.
 - .2 Self-Seal GG-200.
 - .3 Metacaulk Blaze Seal.
- .4 Fire stopping to be done by 07 84 00.

3.11 FLUSHING OUT OF PIPING SYSTEMS

- .1 In accordance with piping sections.
- .2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.12 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

- .1 Advise Departmental Representative 48 hours minimum prior to performance of pressure tests.
- .2 Pipework: Test as specified in relevant sections of Division 23. Where specific pressure testing criteria does not exist, pressure test piping to the greater of 860 kPa or 1-1/2 times the maximum system operating pressure.
- .3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of Division 23.
- .4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.
- .5 Conduct tests in presence of Departmental Representative.
- .6 Pay costs for repairs or replacement, retesting, and making good. Departmental Representative to determine whether repair or replacement is appropriate.
- .7 Insulate or conceal work only after approval and certification of tests by Departmental Representative.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 90.1-13 Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA cosponsored; ANSI approved; Continuous Maintenance Standard).
- .2 Electrical Equipment Manufacturers' Association Council (EEMAC)
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .3 Quality Control: in accordance with Section 01 45 00 - Quality Control.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
- .4 Closeout Submittals: in accordance with Section 01 78 10 - Closeout Submittals.
 - .1 Provide maintenance data for motors, drives and guards for incorporation into manual.

1.4 QUALITY ASSURANCE

- .1 Regulatory Requirements: work to be performed in compliance with CEPA, CEEA, TDGA, and applicable Provincial /Territorial regulations.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Motors: high efficiency, in accordance with local electrical power company standards and to ASHRAE 90.1.

2.2 MOTORS

- .1 Provide motors for mechanical equipment as specified.
- .2 Motors under 373 W (1/2 HP): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, 120 V, unless otherwise specified or indicated.
- .3 Motors 373 W (1/2 HP) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40 degrees C, 3 phase, 575 V, unless otherwise indicated.
- .4 Provide inverter duty motors for variable speed applications.

2.3 TEMPORARY MOTORS

- .1 If delivery of specified motor will delay completion or commissioning work, install motor approved by Departmental Representative for temporary use. Work will only be accepted when specified motor is installed.

2.4 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise indicated.
- .3 For motors under 7.5 kW (10 HP): standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW (10 HP) and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Correct size of sheave determined during commissioning.
- .6 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .7 Motor slide rail adjustment plates to allow for centre line adjustment.
- .8 Supply one set of spare belts for each set.

2.5 DRIVE GUARDS

- .1 Provide guards for unprotected drives.
- .2 Guards for belt drives;
 - .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2 mm thick sheet metal tops and bottoms.
 - .3 38 mm dia holes on both shaft centres for insertion of tachometer.
 - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.

- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6 mm thick galvanized mild steel.
 - .2 Securely fasten in place.
 - .3 Removable for servicing.
- .6 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 19 mm mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Securely fasten in place.
 - .4 Removable for servicing.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Fasten securely in place.
- .2 Make removable for servicing, easily returned into, and positively in position.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing..
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 GENERAL

1.1 SECTIONS INCLUDES

- .1 Materials and installation for thermometers and pressure gauges in piping systems.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 23 05 53.01 - Mechanical Identification.

1.3 REFERENCES

- .1 American Society of Mechanical Engineers (ASME).
 - .1 ASME B40.100-2005, Pressure Gauges and Gauge Attachments.
 - .2 ASME B40.200-2008, Thermometers, Direct Reading and Remote Reading.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-14.4-M88, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
 - .2 CAN/CGSB-14.5-M88, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data.
- .3 Submit manufacturer's product data for following items:
 - .1 Thermometers.

- .2 Pressure gauges.
- .3 Stop cocks.
- .4 Syphons.
- .5 Wells.

1.5 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Design point to be at mid-point of scale or range.
- .2 Ranges: as required. Where pressure gauges are across pumps, etc, both pressure values shall fall within scale or range.

2.2 DIRECT READING THERMOMETERS

- .1 Industrial, variable angle type, liquid filled, 125 mm scale length: to CAN/CGSB 14.4 ASME B40.200.

2.3 REMOTE READING THERMOMETERS

- .1 100 mm diameter mercury-free liquid filled activated dial type: to CAN/CGSB-14.5 ASME B40.200, accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished brass or stainless steel case for wall mounting.

2.4 THERMOMETER WELLS

- .1 Copper pipe: copper or bronze.
- .2 Steel pipe: brass or stainless steel.

2.5 PRESSURE/VACUUM GAUGES

- .1 112 mm, dial type: to ASME B40.100, Grade 2A, stainless steel phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified..
- .2 Provide:
 - .1 Snubber for pulsating operation.
 - .2 Diaphragm assembly for corrosive service.
 - .3 Gasketed pressure relief back with solid front.
 - .4 NPS 1/4 ball valve for gauge isolation.
 - .5 Oil filled for high vibration applications.

PART 3 EXECUTION

3.1 GENERAL

- .1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

- .1 Install in wells on piping. Provide heat conductive material inside well.
- .2 Install in locations as indicated and on inlet and outlet of:

- .1 Water heating and cooling coils.
- .2 DHW tanks.
- .3 Heat exchangers.
- .3 Install wells for balancing purposes.
- .4 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

- .1 Install pressure gauges in following locations:
 - .1 Suction and discharge of pumps.
 - .2 Upstream and downstream of control valves.
 - .3 On inlets and outlets of heat exchangers.
 - .4 In other locations as indicated.
- .2 Install gauge cocks for balancing purposes, elsewhere as indicated.
- .3 Use extensions where pressure gauges are installed through insulation.

3.4 NAMEPLATES

- .1 Install engraved lamicoid nameplates as specified in Section 23 05 53.01 - Mechanical Identification, identifying medium.

3.5 FIELD QUALITY CONTROL

- .1 Performance verification:
 - .1 Refer to commissioning plan

PART 1 GENERAL

1.1 SUMMARY

- .1 Related Sections:
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 01 35 23 - Health and Safety.
 - .3 Section 23 05 05 - Installation of Pipework.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME).
 - .1 ANSI/ASME B1.20.1-1983(R2001), Pipe Threads, General Purpose (Inch).
 - .2 ANSI/ASME B16.18-2012, Cast Copper Alloy Solder Joint Pressure Fittings.
- .2 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A 276-10, Specification for Stainless Steel Bars and Shapes.
 - .2 ASTM B 62-09, Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B 283-10, Specification for Copper and Copper Alloy Die Forgings (Hot-Pressed).
 - .4 ASTM B 505/B 505M-12a, Specification for Copper-Base Alloy Continuous Castings.
 - .1 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
 - .2 MSS-SP-25-2008, Standard Marking System for Valves, Fittings, Flanges and Unions.
 - .3 MSS-SP-80-2008, Bronze Gate Globe, Angle and Check Valves.
 - .4 MSS-SP-110-2010, Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Submit data for valves specified in this section.
- .4 Closeout Submittals: in accordance with Section 01 78 10 – Closeout Submittals.
 - .1 Submit maintenance data for incorporation into manual.

1.4 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Valves:
 - .1 Except for specialty valves, to be single manufacturer.
 - .2 All products to have CRN registration numbers.
- .2 End Connections:
 - .1 Connection into adjacent piping/tubing:
 - .1 Steel pipe systems: Screwed ends to ANSI/ASME B1.20.1.
 - .2 Copper tube systems: Solder ends to ANSI/ASME B16.18.
- .3 Lockshield Keys:
 - .1 Where lockshield valves are specified, provide 10 keys of each size: malleable iron cadmium plated.

- .4 Gate Valves:
 - .1 Requirements common to gate valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Bonnet: union with hexagonal shoulders.
 - .3 Connections: screwed with hexagonal shoulders.
 - .4 Inspection and pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - .5 Packing: non-asbestos.
 - .6 Handwheel: non-ferrous.
 - .7 Handwheel Nut: bronze to ASTM B 62.
 - .2 NPS 2 and under, non-rising stem, solid wedge disc, Class 125
 - .1 Body: with long disc guides, screwed bonnet with stem retaining nut.
 - .2 Operator: Handwheel.
 - .3 NPS 2 and under, rising stem, split wedge disc, Class 125:
 - .1 Body: with long disc guides, screwed bonnet.
 - .2 Disc: split wedge, bronze to ASTM B 283, loosely secured to stem.
 - .3 Operator: Handwheel Lockshield.
 - .4 NPS 2 and under, rising stem, solid wedge disc, Class 125:
 - .1 Body: with long disc guides, screwed bonnet.
 - .2 Operator: Handwheel.
- .5 Globe Valves:
 - .1 Requirements common to globe valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Bonnet: union with hexagonal shoulders.
 - .3 Connections: screwed with hexagonal shoulders.
 - .4 Pressure testing: to MSS SP-80. Tests to be hydrostatic.
 - .5 Stuffing box: threaded to bonnet with gland follower, packing nut, high grade non-asbestos packing.
 - .6 Handwheel: non-ferrous.
 - .7 Handwheel Nut: bronze to ASTM B 62.
 - .2 NPS 2 and under, PTFE disc, Class 125:
 - .1 Body and bonnet: screwed bonnet.

- .2 Disc and seat: renewable rotating PTFE disc, regrindable bronze seat, loosely secured to bronze stem to ASTM B 505.
- .3 Operator: Handwheel, except lock shield on normally closed bypass valves.
- .3 NPS 2 and under, plug disc, Class 150, screwed ends:
 - .1 Body and bonnet: union bonnet.
 - .2 Disc and seat ring: tapered plug type with disc stem ring of AISI S420 stainless steel to ASTM A 276, loosely secured to stem.
 - .3 Operator: Handwheel.
- .6 Check Valves:
 - .1 Requirements common to check valves, unless specified otherwise:
 - .1 Standard specification: MSS SP-80.
 - .2 Connections: screwed with hexagonal shoulders.
 - .2 NPS 2 and under, swing type, bronze disc, Class 125:
 - .1 Body: Y-pattern with integral seat at 45 degrees, screw-in cap with hex head.
 - .2 Disc and seat: renewable rotating disc, two-piece hinge disc construction; seat: regrindable.
- .7 Ball Valves:
 - .1 NPS 2 and under:
 - .1 Body and cap: cast high tensile bronze to ASTM B 62.
 - .2 Pressure rating: Class 125.
 - .3 Connections: Screwed ends to ANSI B1.20.1 and with hexagonal shoulders, or solder ends to ANSI or as required.
 - .4 Stem: tamperproof ball drive.
 - .5 Stem packing nut: external to body.
 - .6 Ball and seat: replaceable stainless steel or hard chrome solid ball and teflon seats.
 - .7 Stem seal: TFE with external packing nut.
 - .8 Operator: removable lever handle.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Remove internal parts before soldering.
- .3 Install valves with unions at each piece of equipment arranged to allow servicing, maintenance, and equipment removal.

PART 1 GENERAL

1.1 RELATED WORK

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCES

- .1 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1-2012, Power Piping.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A 125-96(2007), Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A 307-12, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A 563-07a, Specification for Carbon and Alloy Steel Nuts.
- .3 Factory Mutual (FM)
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP 58-2009, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - .2 ANSI/MSS SP69-2009, Pipe Hangers and Supports - Selection and Application.
 - .3 MSS SP 89-2009, Pipe Hangers and Supports - Fabrication and Installation Practices.
- .6 Underwriter's Laboratories of Canada (ULC)

1.3 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
 - .2 Base maximum load ratings on allowable stresses prescribed by MSS SP 58. ASME B31.1 or
 - .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
 - .4 Design hangers and supports to support systems under conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
 - .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment in accordance with MSS SP 58.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit shop drawings and product data for following items:
 - .1 Bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.

.4 Closeout Submittals: in accordance with Section 01 78 10 – Closeout Submittals.

.1 Provide maintenance data for incorporation into manual.

1.5 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Packing, shipping, handling and unloading:

.1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.

.2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

PART 2 PRODUCTS

2.1 GENERAL

.1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS SP 58.

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: galvanized after manufacture.
 - .2 Use electro-plating galvanizing process or hot dipped galvanizing process.
 - .3 Ensure steel hangers in contact with copper piping are copper plated.
- .2 Upper attachment structural: suspension from Wood Trusses and Roof Framing. Contractor shall supply additional misc. material:
 - .1 Cold piping NPS 2 maximum:
 - .1 Rod: 13 mm FM approved.
 - .2 Cold piping NPS 2 1/2 or greater, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed FM approved to MSS-SP 58 and MSS-SP 69.
- .3 Upper attachment structural: suspension from Wood Truss and Roof Framing. Contractor shall supply additional misc. material:
 - .1 Cold piping NPS 2 maximum.
 - .2 Cold piping NPS 2 1/2 or greater, clamp with hooked rod, spring washer, plain washer and nut UL listed, FM approved.
- .4 Upper attachment to concrete:
 - .1 Ceiling: carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate UL listed, FM approved to MSS SP 69.
- .5 Shop and field-fabricated assemblies:
 - .1 Trapeze hanger assemblies: as indicated.
- .6 Hanger rods: threaded rod material to MSS SP 58:
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.

- .3 Do not use 22 mm or 28 mm rod.
- .7 Pipe attachments: material to MSS SP 58:
 - .1 Attachments for steel piping: carbon steel, black.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for hot pipework.
 - .4 Oversize pipe hangers and supports.
- .8 Adjustable clevis: material to MSS SP 69 UL listed FM approved, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.
- .9 Yoke style pipe roll: carbon steel yoke, rod and nuts with cast iron roll, to MSS SP 69.
- .10 U-bolts: carbon steel to MSS SP 69 with 2 nuts at each end to ASTM A 563.
 - .1 Finishes for steel pipework: black, except galvanized in wash bays.
 - .2 Finishes for copper, glass, brass or aluminum pipework: black, except galvanized in corrosion control hangar, with formed portion plastic coated.
- .11 Pipe rollers: cast iron roll and roll stand with carbon steel rod to MSS SP 69.

2.3 RISER CLAMPS

- .1 Steel or cast iron pipe: black, carbon steel to MSS SP 58, type 42, UL listed, FM approved.
- .2 Copper pipe: carbon steel copper plated to MSS SP 58, type 42.
- .3 Bolts: to ASTM A 307.
- .4 Nuts: to ASTM A 563.

2.4 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .1 64 kg/m³ density insulation plus insulation protection shield to: MSS SP 69, galvanized sheet carbon steel. Length designed for maximum 3 m span.
- .2 Insulated hot piping:
 - .1 Curved plate 300 mm long, with edges turned up, welded-in centre plate for pipe sizes NPS 12 and over, carbon steel to comply with MSS SP 69.

2.5 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings. Submit calculations with shop drawings.

2.6 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

2.7 OTHER PIPING AND EQUIPMENT SUPPORTS

- .1 Fabricate other piping and equipment supports from structural grade steel meeting requirements of Section 05 12 23 - Structural Steel for Buildings.
- .2 Submit structural calculations with shop drawings.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, air handlers, condensing units and as indicated.
- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to industry standards.
 - .3 Steel pipes: install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: install below joint.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts, one at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

3.3 HANGER SPACING

- .1 Plumbing piping: to Canadian Plumbing Code authority having jurisdiction.
- .2 Fire protection: to applicable fire code.
- .3 Fuel oil piping: up to NPS 1/2: every 1.8 m.
- .4 Flexible joint roll groove pipe: in accordance with table below, but not less than one hanger at joints.
- .5 Within 300 mm of each elbow.

Maximum Pipe Size: NPS	Maximum Spacing Steel	Maximum Spacing Copper
Up to 1-1/4	2.1 m	1.8 m
1-1/2	2.7 m	2.4 m
2	3.0 m	2.7 m
2-1/2	3.6 m	3.0 m
3	3.6 m	3.0 m
3-1/2	3.9 m	3.3 m
4	4.2 m	3.6 m
5	4.8 m	
6	5.1 m	
8	5.7 m	
10	6.6 m	
12	6.9 m	

- .6 Pipework greater than NPS 12: to MSS SP 69.

3.4 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

3.5 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4 degrees from vertical.
- .2 Where horizontal pipe movement is less than 13 mm, offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.6 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
- .1 Ensure that rod is vertical under operating conditions.
- .2 Equalize loads.

- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.

3.7 FIELD QUALITY CONTROL

- .1 Site Tests: conduct following tests in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - SUBMITTALS.
- .2 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.
- .3 Performance verification:
 - .1 Refer to commissioning plan.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 21 13 13 - Wet Pipe Sprinkler Systems.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 National Fire Protection Association (NFPA)
 - .1 NFPA 13-2013, Standard for the Installation of Sprinkler Systems.
- .3 National Building Code of Canada (NBC)- 2010.

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of workplace Hazardous Materials Information system (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide separate shop drawings for each isolated system. System shop drawings complete with performance and product data.
 - .2 Provide detailed drawings of seismic control measures for all equipment, piping and duct.
 - .3 Indicate interior bases and locate vibration isolators, with static and dynamic loads on each.
- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

- .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .2 Instructions: submit manufacturer's installation instructions.
- .3 Manufacturer's Field Reports: manufacturer's field reports specified.
- .4 Product Data: Provide schedule of vibration isolator type and seismic restraint type with location and load on each.
- .5 Record actual locations of seismic restraints including attachment points on drawings and provide to Departmental Representative.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Provide maintenance data for incorporation into manual

1.5 QUALITY ASSURANCE

- .1 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Size and shape of bases type and performance of vibration isolation specified in technical section and indicated elsewhere.

2.2 ELASTOMERIC PADS

- .1 Type EP1 - neoprene waffle or ribbed; 10 mm minimum thick; 50 durometer; maximum loading 350 kPa.
- .2 Type EP2 - rubber waffle or ribbed 10 mm minimum thick; 30 durometer natural rubber; maximum loading 415 kPa.
- .3 Type EP3 - neoprene-steel-neoprene; 10 mm minimum thick neoprene bonded to 1.71 mm steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa.
- .4 Type EP4 - rubber-steel-rubber; 10 mm minimum thick rubber bonded to 1.71 mm steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa.

2.3 ELASTOMERIC MOUNTS

- .1 Type M1 - colour coded; neoprene in shear; maximum durometer of 60; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

2.4 SPRINGS

- .1 Design stable springs: ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height. Select for 50% travel beyond rated load. Units complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring between 0.8 to 1.0.
- .3 Cadmium plate for outdoor and 100% relative humidity installations.
- .4 Colour code springs.

2.5 SPRING MOUNT

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .2 Type M3 - stable open spring: 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; levelling bolt for rigidly mounting to equipment.
- .3 Type M4 - restrained stable open spring: supported on bonded 6 mm minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
- .4 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg maximum.
- .5 Performance: 50 mm static deflection unless noted otherwise.

2.6 HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30 degrees arc without metal to metal contact.
- .2 Type H2 - stable spring, elastomeric washer, cup with moulded isolation bushing which passes through hanger box.
- .3 Type H3 - stable spring, elastomeric element, cup with moulded isolation bushing which passes through hanger box.
- .4 Performance: as required.

2.7 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

- .1 Acoustic barriers: between pipe and support, consisting of 25 mm minimum thick heavy duty duck and neoprene isolation material.

2.8 HORIZONTAL THRUST RESTRAINT

- .1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 9 mm.
- .2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install vibration isolation equipment in accordance with manufacturers' instructions and adjust mountings to level equipment.
- .2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm minimum static deflection as follows:
- .4 Up to NPS 4: first 3 points of support. NPS 5 to NPS 8: first 4 points of support. NPS 10 and Over: first 6 points of support.
- .5 First point of support: static deflection of twice deflection of isolated equipment, but not more than 50 mm.
- .6 Where isolation is bolted to floor use vibration isolation rubber washers.
- .7 Block and shim level bases so that ductwork and piping connections can be made to rigid system at operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.3 FIELD QUALITY CONTROL

- .1 Inspection and Certification:
 - .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
 - .2 Take vibration measurements for all rotating equipment listed below:
 - .1 Fans.
 - .2 Packaged equipment with motorized components, excluding motorized valve actuators.
 - .3 Provide Departmental Representative with notice 24 h in advance of commencement of tests.
 - .4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations (including sound curves).
 - .5 Submit complete report of test results including sound curves.
 - .6 Refer to commissioning plan.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCES

- .1 Canadian Gas Association (CGA)
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-24.3-92, Identification of Piping Systems.
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 13-2013, Standard for the Installation of Sprinkler Systems.

1.3 SUBMITTALS

- .1 Product Data:
- .2 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Product data to include paint colour chips, other products specified in this section.
- .4 Samples:
 - .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Samples to include nameplates, labels, tags, lists of proposed legends.
- .5 Closeout Submittals: in accordance to Section 01 78 10 – Closeout Submittals.
 - .1 Provide maintenance data for incorporation into manual.

1.4 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

PART 2 PRODUCTS

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic laminate nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.

- .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm thick laminated plastic or white anodized aluminum, matte finish, with square corners, letters accurately aligned and machine engraved into core.
- .3 Sizes:
 - .1 Conform to following table:

Size #	mm	Sizes (mm)	No. of Lines	Height of Letters (mm)
1		10 x 50	1	3
2		13 x 75	1	5
3		13 x 75	2	3
4		20 x 100	1	8
5		20 x 100	2	5
6		20 x 200	1	8
7		25 x 125	1	12
8		25 x 125	2	8
9		35 x 200	1	20
 - .2 Use maximum of 25 letters/numbers per line.
- .4 Locations:
 - .1 Terminal cabinets, control panels: use size # 5.
 - .2 Equipment in Mechanical Rooms: use size # 9.

2.3 PIPING SYSTEMS GOVERNED BY CODES

- .1 Identification:
 - .1 Sprinklers: to NFPA 13.
 - .2 Other fire protection systems: in accordance with applicable codes and standards, and in accordance with authority having jurisdiction.

2.4 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Pictograms:
 - .1 Where required: Workplace Hazardous Materials Information System (WHMIS) regulations.
- .3 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB 24.3.
- .4 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm: 100 mm long x 50 mm high.
 - .2 Outside diameter of pipe or insulation 75 mm and greater: 150 mm long x 50 mm high.
 - .3 Use double-headed arrows where flow is reversible.
- .5 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .6 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm and smaller: waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150 degrees C and intermittent temperature of 200 degrees C.
- .7 Colours and Legends:
 - .1 Where not listed, obtain direction from Departmental Representative.
 - .2 Colours for legends, arrows: to following table:

Background colour: Legend, arrows:

Yellow	BLACK
Green	WHITE
Red	WHITE

.3 Background colour marking and legends for piping systems:

Contents	Background colour	Legend Marking
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HWS recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Storm water	Green	STORM
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS

2.5 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm high stencilled letters and directional arrows 150 mm long x 50 mm high.
- .2 Colours: black, or co-ordinated with base colour to ensure strong contrast.

2.6 VALVES, CONTROLLERS

- .1 Brass tags with 12 mm stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

2.7 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.

2.8 LANGUAGE

- .1 Identification in English.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 TIMING

- .1 Provide identification only after painting specified Section 09 91 00 - Painting has been completed.

3.3 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and or CSA registration plates as required by respective agency.

3.4 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.

- .3 Protection:
 - .1 Do not paint, insulate or cover.

3.5 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in equipment rooms, galleries: at not more than 17 m intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, confined spaces, at entry and exit points, and at access openings.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, and dampers. Where this is not possible, place identification as close as possible, preferably on upstream side.
- .9 Identification easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.6 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Departmental Representative. Provide one copy (reduced in size if required) in each operating and maintenance manual.

- .3 Number valves in each system consecutively.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 GENERAL

- .1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do other work as specified in this section.

1.3 QUALIFICATIONS OF TAB PERSONNEL

- .1 Names of proposed personnel to perform TAB to be submitted to and approved by Departmental Representative within 90 days of award of contract.
- .2 Provide documentation confirming qualifications, successful experience.

1.4 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads
- .2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.5 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

1.6 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems.

1.7 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started and confirm in writing to Departmental Representative adequacy of provisions for TAB and other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Departmental Representative in writing all proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of TAB devices, equipment, accessories, measurement ports and fittings.

1.8 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in Divisions 22 and 23.

1.9 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by Departmental Representative for verification of TAB reports.

1.10 START OF TAB

- .1 Notify Departmental Representative 7 days prior to start of TAB.
- .2 Start TAB when building is essentially completed, including:

- .3 Installation of ceilings, doors, windows, other construction affecting TAB.
- .4 Application of weatherstripping, sealing, caulking.
- .5 All pressure, leakage, other tests specified elsewhere Divisions 22 and 23.
- .6 All provisions for TAB installed and operational.
- .7 Start-up, verification for proper, normal and safe operation of mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, volume control dampers installed and open.
 - .6 Coil fins combed, clean.
 - .7 Access doors, installed, closed.
 - .8 Outlets installed, volume control dampers open.
 - .3 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.
 - .4 Isolating and balancing valves installed, open.
 - .5 Calibrated balancing valves installed, at factory settings.
 - .6 Chemical treatment systems complete, operational.

1.11 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems: plus 5%, minus 5%.

1.12 ACCURACY TOLERANCES

- .1 Measured values to be accurate to within plus or minus 2% of actual values.

1.13 INSTRUMENTS

- .1 Prior to TAB, submit to Departmental Representative list of instruments to be used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Departmental Representative.

1.14 SUBMITTALS

- .1 Submit, prior to commencement of TAB:
- .2 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.15 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of Departmental Representative, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.16 TAB REPORT

- .1 Format to be in accordance with referenced standard.
- .2 TAB report to show results in SI units and to include:

- .1 Project record drawings.
- .2 System schematics.
- .3 Submit 6 copies of TAB Report to Departmental Representative for verification and approval, in English in D-ring binders, complete with index tabs.

1.17 VERIFICATION

- .1 Reported results subject to verification by Departmental Representative.
- .2 Provide manpower and instrumentation to verify up to 30 % of reported results.
- .3 Number and location of verified results to be at discretion of. Departmental Representative.
- .4 Bear costs to repeat TAB as required to satisfaction of Departmental Representative.

1.18 SETTINGS

- .1 After TAB is completed to satisfaction of Departmental Representative, replace drive guards, close access doors, lock devices in set positions, ensure sensors are at required settings.
- .2 Permanently mark settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.19 COMPLETION OF TAB

- .1 TAB to be considered complete when final TAB Report received and approved by Departmental Representative.

1.20 AIR SYSTEMS

- .1 Standard: TAB to be to most stringent of this section or TAB standards of AABC or NEBB.
- .2 Do TAB of systems, equipment, components, controls specified in Divisions 22 and 23.

- .3 Qualifications: personnel performing TAB to be current member in good standing of AABC or NEBB.
- .4 Quality assurance: Perform TAB under direction of supervisor qualified by AABC or NEBB.
- .5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.
- .6 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
- .7 Inlet and outlet of dampers, filter, coil, humidifier, fan, other equipment causing changes in conditions.
- .8 At controllers, controlled device.
- .9 Locations of systems measurements to include, but not be limited to, following as appropriate: Main ducts, main branch, sub-branch, run-out (or grille, register or diffuser).

1.21 OTHER SYSTEMS

- .1 Refrigeration systems forming part of HVAC systems.

1.22 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to work specified this paragraph:
 - .1 Qualifications of TAB personnel: as for air systems specified this section.
 - .2 Quality assurance: as for air systems specified this section.

1.23 POST OCCUPANCY TAB

- .1 Measure DBT, WBT, air velocity, air flow patterns, NC levels in occupied areas as designated by the Departmental Representative.
- .2 Participate in systems checks twice during warranty period - #1 approximately 3 months after acceptance and #2 within 1 month of termination of warranty period.

PART 2 PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 EXECUTION

3.1 NOT USED

.1 Not used.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE/IESNA 90.1-10, SI; Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM B 209M-10, Specification for Aluminum and Aluminum Alloy Sheet and Plate (Metric).
 - .2 ASTM C 335-10e1, Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C 411-11, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449-07(2013), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 547-12, Specification for Mineral Fiber Pipe Insulation.
 - .6 ASTM C 553-11, Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C 612-10, Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C 795-08, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.
 - .9 ASTM C 921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52MA, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .4 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (R1999).

- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-10, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-11, Thermal Insulation Polystyrene, Boards and Pipe Covering.

1.3 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as defined herein.
 - .3 Insulation systems - insulation material, fasteners, jackets, and other accessories.
- .2 TIAC Codes:
 - .1 CRD: Code Round Ductwork,
 - .2 CRF: Code Rectangular Finish.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

1.5 MANUFACTURERS' INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Installation instructions to include procedures used, and installation standards achieved.

1.6 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Provide maintenance data for incorporation into manual

1.7 QUALIFICATIONS

- .1 Installer: specialist in performing work of this section, and have at least 3 years successful experience in this size and type of project, qualified to standards member of TIAC.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Protect from weather and construction traffic.
- .3 Protect against damage from any source.

PART 2 PRODUCTS

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102-10:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre: as specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24° C mean temperature when tested in accordance with ASTM C 335-05.

- .3 TIAC Code C-1: Rigid mineral fibre board to ASTM C 612, with or without factory applied vapour retarder jacket to CGSB 51-GP-52MA (as scheduled in PART 3 of this Section).
- .4 TIAC Code C-2: Mineral fibre blanket to ASTM C 553 faced with or without factory applied vapour retarder jacket to CGSB 51-GP-52MA (as scheduled in PART 3 of this section).
 - .1 Mineral fibre: to ASTM C 553.
 - .2 Jacket: to CGSB 51-GP-52MA.
 - .3 Maximum "k" factor: to ASTM C 553.

2.3 JACKETS

- .1 Canvas:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
- .2 Lagging adhesive: Compatible with insulation.

2.4 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
 - .1 Vinyl emulsion type acrylic, compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C449-07.
- .4 ULC Listed Canvas Jacket:
 - .1 220 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921-09 untreated.
- .5 Outdoor Vapour Retarder Mastic:
 - .1 Vinyl emulsion type acrylic compatible with insulation.
 - .2 Reinforcing fabric: Fibrous glass, untreated 305 g/m².
- .6 Tape: self-adhesive, aluminum, plain reinforced, 75 mm wide minimum.
- .7 Contact adhesive: quick-setting

- .8 Canvas adhesive: washable.
- .9 Tie wire: 1.5 mm stainless steel.
- .10 Banding: 19 mm wide, 0.5 mm thick stainless steel.
- .11 Fasteners: 4 mm diameter pins with 35 mm diameter clips, length to suit thickness of insulation.
- .12 Facing: 25 mm stainless steel hexagonal wire mesh stitched on one face.

PART 3 EXECUTION

3.1 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure testing of ductwork systems complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers' instructions and as indicated.
- .3 Use two layers with staggered joints when required nominal thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
- .5 Supports, Hangers in accordance with Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .6 Fasteners: At 300 mm oc in horizontal and vertical directions, minimum two rows each side.

- .7 Any blanked off sections of louvres to be insulated with 100 mm thick insulation sandwiched between 2 sheets of galvanized steel.

3.3 DUCTWORK INSULATION SCHEDULE

- .1 Insulation types and thicknesses: Conform to following table:

	TIAC Code	Vapour Retarder	Thickness (mm)
Rectangular cold and dual temperature supply air ducts	C-1	yes	25
Round cold and dual temperature supply air ducts	C-2	yes	25
Rectangular warm air ducts	C-1	no	25
Return and Exhaust Ducts exposed in space being served		none (unless indicated on drawing)	
Outside air ducts and combustion air ducting	C-1	yes	50

Mixing plenums	C-1	yes	50
Exhaust duct to 3000 mm from discharge location between dampers and louvres	C-1	yes	50
Acoustically lined ducts	none		

.2 Insulation finishes: conform to the following table:

<u>Location</u>	<u>Finish</u>
Exposed rectangular duct	Canvas
Exposed round duct	Canvas or PVC
Concealed ducts	None

.3 C-2 type insulation can be used for all rectangular or round, interior, concealed ductwork.

3.4 FIELD QUALITY CONTROL

.1 Performance Verification:

.1 Refer to commissioning plan.

PART 1 GENERAL

1.1 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - .1 ASHRAE Standard 90.1-01, Energy Standard for Buildings Except Low-Rise Residential Buildings (IESNA co-sponsored; ANSI approved; Continuous Maintenance Standard).
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM B 209M-12, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate Metric.
 - .2 ASTM C 335-10e1, Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation.
 - .3 ASTM C 411-11, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C 449-07(2013), Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .5 ASTM C 547-12, Mineral Fiber Pipe Insulation.
 - .6 ASTM C 795-08, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .7 ASTM C 921-10, Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- .3 Canadian General Standards Board (CGSB)
 - .1 CGSB 51-GP-52Ma-89, Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .2 CAN/CGSB-51.53-95, Poly (Vinyl Chloride) Jacketing Sheet, for Insulated Pipes, Vessels and Round Ducts
- .4 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Assessment Act (CEAA), 1995, c. 37.
 - .2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

- .5 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .6 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC): National Insulation Standards (Revised 2004).
- .7 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102-07, Surface Burning Characteristics of Building Materials and Assemblies.
 - .2 CAN/ULC-S701-11, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .3 CAN/ULC-S702-09, Thermal Insulation, Mineral Fibre, for Buildings
 - .4 CAN/ULC-S702.2-10, Thermal Insulation, Mineral Fibre, for Buildings, Part 2: Application Guidelines.

1.2 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as specified.
- .2 TIAC ss:
 - .1 CRF: Code Rectangular Finish.
 - .2 CPF: Code Piping Finish.

1.3 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00- Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

- .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
- .5 Closeout Submittals: in accordance to Section 01 78 10 – Closeout Submittals.
 - .1 Provide maintenance data for incorporation into manual.

1.4 QUALITY ASSURANCE

- .1 Qualifications:
- .2 Installer: specialist in performing work of this Section, and have at least 3 years successful experience in this size and type of project, qualified to standards member of TIAC.
- .3 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

- .3 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Storage and Protection:
 - .1 Protect from weather, construction traffic.
 - .2 Protect against damage.
 - .3 Store at temperatures and conditions required by manufacturer.

PART 2 PRODUCTS

2.1 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102.
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.2 INSULATION

- .1 Mineral fibre specified includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24 degrees C mean temperature when tested in accordance with ASTM C 335.
- .3 TIAC Code A-1: rigid moulded mineral fibre without factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702 ASTM C 547.
 - .2 Maximum "k" factor: to CAN/ULC-S702.
- .4 TIAC Code A-3: rigid moulded mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: to CAN/ULC-S702 ASTM C 547.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor: to CAN/ULC-S702 ASTM C 547.
- .5 TIAC Code C-2: mineral fibre blanket faced with factory applied vapour retarder jacket.

- .1 Mineral fibre: to CAN/ULC-S702 ASTM C 547.
- .2 Jacket: to CGSB 51-GP-52Ma.
- .3 Maximum "k" factor: to CAN/ULC-S702 ASTM C 547.
- .6 TIAC Code A-6: flexible unicellular tubular elastomer.
 - .1 Insulation: with vapour retarder jacket.
 - .2 Jacket: to CGSB 51-GP-52Ma.
 - .3 Maximum "k" factor:.
 - .4 Certified by manufacturer: free of potential stress corrosion cracking corrodants.

2.3 INSULATION SECUREMENT

- .1 Tape: self-adhesive, aluminum, reinforced, 50 mm wide minimum.
- .2 Contact adhesive: quick setting.
- .3 Canvas adhesive: washable.
- .4 Tie wire: 1.5 mm diameter stainless steel.
- .5 Bands: stainless steel, 19 mm wide, 0.5 mm thick.

2.4 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 Hydraulic setting or Air drying on mineral wool, to ASTM C 449/C 449M.

2.5 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

2.6 INDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.

2.7 OUTDOOR VAPOUR RETARDER FINISH

- .1 Vinyl emulsion type acrylic, compatible with insulation.
- .2 Reinforcing fabric: fibrous glass, untreated 305 g/m².

2.8 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 One-piece moulded type and sheet to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .2 Colours: to match adjacent finish paint by Departmental Representative.
 - .3 Minimum service temperatures: -20 degrees C.
 - .4 Maximum service temperature: 65 degrees C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Thickness: 0.5 mm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
 - .8 Special requirements:
 - .1 Outdoor: UV rated material at least 0.5 mm thick.
- .2 ABS Plastic:
 - .1 One-piece moulded type and sheet with pre-formed shapes as required.
 - .2 Colours: to match adjacent finish paint.
 - .3 Minimum service temperatures: -40 degrees C.
 - .4 Maximum service temperature: 82 degrees C.
 - .5 Moisture vapour transmission: 0.012 perm.
 - .6 Thickness: 0.75 mm.
 - .7 Fastenings:

- .1 Solvent weld adhesive compatible with insulation to seal laps and joints.
- .2 Tacks.
- .3 Pressure sensitive vinyl tape of matching colour.
- .8 Locations:
 - .1 For outdoor use ONLY.
- .3 Canvas:
 - .1 220 and 120 gm/m² cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
 - .2 Lagging adhesive: compatible with insulation.
- .4 Stainless steel:
 - .1 Type: 304 or 316.
 - .2 Thickness: 0.25 mm.
 - .3 Finish: corrugated.
 - .4 Joining: longitudinal and circumferential slip joints with 50 mm laps.
 - .5 Fittings: 0.5 mm thick die-shaped fitting covers with factory-attached protective liner.
 - .6 Metal jacket banding and mechanical seals: stainless steel, 19 mm wide, 0.5 mm thick at 300 mm spacing.

2.9 WEATHERPROOF CAULKING FOR JACKETS INSTALLED OUTDOORS

- .1 Caulking to: Section 07 92 00 - Joint Sealing.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 PRE-INSTALLATION REQUIREMENT

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed and certified.
- .2 Surfaces clean, dry, free from foreign material.

3.3 INSTALLATION

- .1 Install in accordance with TIAC National Standards.
- .2 Apply materials in accordance with manufacturers' instructions and this specification.
- .3 Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Install hangers, supports outside vapour retarder jacket.
- .5 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

3.4 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: at expansion joints, valves, primary flow measuring elements flanges and unions at equipment.
- .2 Design: to permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.
- .3 Insulation:
 - .1 Insulation, fastenings and finishes: same as system.
 - .2 Jacket: PVC.

3.5 INSTALLATION OF ELASTOMERIC INSULATION

- .1 Insulation to remain dry. Overlaps to manufacturers' instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

3.6 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges and fittings unless otherwise specified.
- .2 TIAC Code: A-1.
 - .1 Securements: SS wire or band at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code 1501-H.
- .3 TIAC Code: A-3.
 - .1 Securements: SS wire or bands at 300 mm on centre.
 - .2 Seals: VR lap seal adhesive, VR lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .4 TIAC Code: A-6.
 - .1 Insulation securements: as recommended by manufacturer.
 - .2 Seals: lap seal adhesive, lagging adhesive.

- .3 Installation: TIAC Code: 1501-C.
- .5 TIAC Code: C-2 with vapour retarder jacket.
 - .1 Insulation securements: SS wire or bands at 300 mm on centre.
 - .2 Seals: lap seal adhesive, lagging adhesive.
 - .3 Installation: TIAC Code: 1501-C.
- .6 Thickness of insulation as listed in following table.
 - .1 Run-outs to individual units and equipment not exceeding 4000 mm long.
 - .2 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Applic Temp TIAC Pipe sizes (NPS) and insulation thickness
ation degrees code (mm)

	C	TIAC Code					
		Run Out	to 1	1 ¼ to 2	2 ½ to 4	5 to 6	8 & over
Domestic HWS and recirculation water	A-1	25	25	25	38	38	38
Humidification steam	A-1	38	38	50	50	50	50
Domestic CWS	A-3	25	25	25	25	25	25
Tempered water	A-1	25	25	25	25	25	25
Refrigerant hot gas liquid suction	4-13 A-6	25	25	25	25	25	25

Refrigerant 4 hot gas liquid suction	A-6	25	25	38	38	38	38
RWL and RWP	C-2	25	25	25	25	25	25
Cooling coil cond. drain	A-3	25	25	25	25	25	25
Sprinkler drops at OH doors	A-3	50	50	50	50	50	50

.7 Finishes:

- .1 Exposed indoors: PVC jacket.
- .2 Exposed in mechanical rooms: canvas or PVC jacket.
- .3 Concealed, indoors: canvas on valves, fittings. No further finish.
- .4 Use vapour retarder jacket on TIAC code A-3 insulation compatible with insulation.
- .5 Outdoors: water-proof SS or ABS jacket.
- .6 Finish attachments: SS screws or bands, at 150 mm on centre. Seals: wing closed.
- .7 Installation: to appropriate TIAC code CRF/1 through CPF/5.

3.7 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.8 FIELD QUALITY CONTROL

.1 Performance Verification:

.1 Refer to commissioning plan.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 23 05 05 - Installation of Pipework.

1.2 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME B16.22-2013, Wrought Copper and Copper Alloy Solder - Joint Pressure - Fittings.
 - .2 ASME B16.24-2011, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.
 - .3 ASME B16.26-2013 Cast Copper Alloy Fittings for Flared Copper Tubes.
 - .4 ASME B31.5-2013, Refrigeration Piping.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 307-12, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .2 ASTM B 280-13, Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .3 Canadian Standards Association (CSA)
 - .1 CSA B52-09, Mechanical Refrigeration Code.
- .4 Environment Canada (EC)
- .5 EPS 1/RA/1-96, Environmental Code of Practice for the Reduction of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation meetings:
 - .1 Convene pre-installation meeting 1 week prior to beginning work of this section and on-site installation, with departmental representative to:
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.

- .3 Co-ordination with other building construction subtrades.
- .4 Review manufacturer's written installation instructions and warranty requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for refrigerant piping, fittings and equipment and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 23 - Health and Safety and 01 35 26 - Environmental Procedures. Indicate VOC's for adhesive and solvents during application and curing.
 - .3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for refrigerant piping for incorporation into manual.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.

PART 2 PRODUCTS

2.1 TUBING

- .1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.
 - .1 Hard copper: to ASTM B 280-13, type ACR B.
 - .2 Annealed copper: to ASTM B 280-13, with minimum wall thickness as per CSA B52-09 and ASME B31.5-2013.

2.2 FITTINGS

- .1 Service: design pressure 2070 kPa and temperature 121° C.
 - .1 Brazed:
 - .2 Fittings: wrought copper to ASME B16.22-2013.
 - .3 Joints: silver, copper-phosphorous, 95% Cu-5%P and non-corrosive flux.
 - .2 Flared:
 - .1 Bronze or brass, for refrigeration, to ASME B16.26-2013.

2.3 PIPE SLEEVES

- .1 Hard copper or steel, sized to provide 6 mm clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

2.4 VALVES

- .1 22 mm and under: Class 500, 3.5 Mpa, globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moistureproof seal for below freezing applications, brazed connections.
- .2 Over 22 mm: Class 375, 2.5 MPa, globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moistureproof seal for below freezing applications, brazed connections.

PART 3 EXECUTION

3.1 GENERAL

- .1 In accordance with Section 23 05 05 - Installation of Pipework, supplemented as specified herein
- .2 Install in accordance with CSA B52-09, EPS1/RA/1 and ASME B31.5-2001.

3.2 BRAZING PROCEDURES

- .1 Bleed inert gas into pipe during brazing.
- .2 Remove valve internal parts, solenoid valve coils, sight glass.
- .3 Do not apply heat near expansion valve and bulb.

3.3 PIPING INSTALLATION

- .1 General:
 - .1 Soft annealed copper tubing: bend without crimping or constricting Hard drawn copper tubing: do not bend. Minimize use of fittings.
- .2 Hot gas lines:
 - .1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.
 - .2 Provide trap at base of risers greater than 2400 mm high and at each 7600 mm thereafter.
 - .3 Provide inverted deep trap at top of risers.
 - .4 Provide double risers for compressors having capacity modulation.
 - .1 Large riser: install traps as specified above.
 - .2 Small riser: size for 5.1 m/s at minimum load. Connect upstream of traps on large riser.

3.4 PRESSURE AND LEAK TESTING

- .1 Close valves on factory charged equipment and other equipment not designed for test pressures.
- .2 Leak test to CSA B52-S1-09 before evacuation to 2MPa and 1MPa on high and low sides respectively.
- .3 Test Procedure: Initially test with nitrogen and maintain for 12 hours. If loss of pressure occurs, check for leaks with soap and water. If leak cannot be found then build pressure up to 35 kPa with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.5 DEHYDRATION AND CHARGING

- .1 Close service valves on factory charged equipment.
- .2 Ambient temperatures to be at least 13° C for at least 12 hours before and during dehydration.
- .3 Use copper lines of largest practical size to reduce evacuation time.
- .4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5Pa absolute and filled with dehydrated oil.
- .5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.
- .6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:
 - .1 Twice to 14Pa absolute and hold for 4 h.
 - .2 Break vacuum with refrigerant to 14kPa.
 - .3 Final to 5Pa absolute and hold for at least 12 h.
 - .4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.
 - .5 Submit test results to Departmental Representative.
- .7 Charging:
 - .1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.

- .2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.
- .3 Re-purge charging line if refrigerant container is changed during charging process.
- .8 Checks:
 - .1 Make checks and measurements as per manufacturer's operation and maintenance instructions.
 - .2 Record and report measurements to Departmental Representative.

3.6 INSTRUCTIONS

- .1 Post instructions in frame with glass cover CSA B52-09.

3.7 FIELD QUALITY CONTROL

- .1 Performance Verification:
 - .1 Refer to commissioning plan.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 23 - Health and Safety.
- .3 Section 07 84 00 - Firestopping.
- .4 Section 23 05 94 - Pressure Testing of Ducted Air Systems.
- .5 Section 23 31 13.02 - Metal Ducts - High Pressure to 2500 Pa.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM A 480/A 480M-14, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - .2 ASTM A 635/A 635M-13, Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot Rolled.
 - .3 ASTM A 653/A 653M-13, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .3 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-15, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-15, Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - .3 NFPA 91-2010, Standard for Exhaust System for Air Conveying of Vapours, Gases, Mists, and Noncombustible Particle Solids.
 - .4 NFPA 96-2014, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 3rd Edition 2005.
 - .2 SMACNA HVAC Air Duct Leakage Test Manual, 2012, 2nd Edition.

1.3 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

1.4 QUALITY ASSURANCE

- .1 Certification of Ratings:
 - .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Health and Safety: in accordance to Section 01 35 23 – Health and Safety.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.

1.6 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

PART 2 PRODUCTS

2.1 SEAL CLASSIFICATION

.1 Classification as follows:

<u>Maximum Pressure Pa</u>	<u>SMACNA Seal Class</u>
500	C
250	C
125	C
125	Unsealed

.2 Seal classification:

- .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
- .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant tape or combination thereof.
- .3 Class C: transverse joints and connections made air tight with gaskets, seal and tape or combination thereof. Longitudinal seams unsealed.
- .4 Unsealed seams and joints.

2.2 SEALANT

.1 Sealant: oil resistant, water borne, polymer type flame resistant duct sealant. Temperature range of minus 30 degrees C to plus 93 degrees C.

2.3 TAPE

.1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm wide.

2.4 DUCT LEAKAGE

.1 In accordance with SMACNA HVAC Air Duct Leakage Test Manual.

2.5 FITTINGS

.1 Fabrication: to SMACNA.

- .2 Radiused elbows.
 - .1 Rectangular: standard radius short radius with single thickness turning vanes Centreline radius: 1.5 times width of duct.
 - .2 Round: smooth radius five piece. Centreline radius: 1.5 times diameter, where possible..
- .3 Mitred elbows, rectangular:
 - .1 To 400 mm: with single double thickness turning vanes.
 - .2 Over 400 mm: with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with radius on branch 1.5 times width of duct 45 degrees entry on branch.
 - .2 Round main and branch: enter main duct at 45 degrees as shown on drawings.
 - .3 Provide volume control damper in branch duct near connection to main duct.
- .5 Transitions:
 - .1 Diverging: 20 degrees maximum included angle.
 - .2 Converging: 30 degrees maximum included angle.
- .6 Offsets:
 - .1 Full radiused elbows.
- .7 Obstruction deflectors: maintain full cross-sectional area.
 - .1 Maximum included angles: as for transitions.

2.6 FIRE STOPPING

- .1 Retaining angles around duct, on both sides of fire separation in accordance with Section 07 84 00 - Firestopping.
- .2 Fire stopping material and installation must not distort duct.

2.7 GALVANIZED STEEL

- .1 Lock forming quality: to ASTM A 653/A 653M-09, Z90 zinc coating.
- .2 Thickness, fabrication and reinforcement: to ASHRAE SMACNA.

- .3 Joints: to ASHRAE SMACNA proprietary manufactured duct joint. Proprietary manufactured flanged duct joint to be considered to be a class A seal.

2.8 STAINLESS STEEL

- .1 To ASTM A 480/A 480M, Type 304.
- .2 Finish: No. 4.
- .3 Thickness, fabrication and reinforcement: to SMACNA or as indicated.
- .4 Joints: to ASHRAE and SMACNA.
- .5 Welded system.

2.9 ALUMINUM

- .1 To ASHRAE and SMACNA. Aluminum type: 3003-H-14.
- .2 Thickness, fabrication and reinforcement: to SMACNA.
- .3 Joints: to SMACNA.
- .4 Dryer exhaust.

2.10 HANGERS AND SUPPORTS

- .1 Hangers and Supports: in accordance with Section 23 05 29 - Hangers and Supports For HVAC Piping and Equipment.
- .2 Strap hangers: of same material as duct but next sheet metal thickness heavier than duct. Maximum size duct supported by strap hangers: 500 mm.
- .3 Hanger configuration: to ASHRAE and SMACNA.
- .4 Hangers: galvanized steel angle with galvanized steel rods to ASHRAE and SMACNA following table:

Duct Size (mm)	Angle Size (mm)	Rod Size mm)
up to 750	25 x 25 x 3	6
751 to 1050	40 x 40 x 3	6
1051 to 1500	40 x 40 x 3	10
1501 to 2100	50 x 50 x 3	10
2101 to 2400	50 x 50 x 5	10
2401 and over	50 x 50 x 6	10

- .5 Upper hanger attachments:
- .1 For concrete: manufactured concrete inserts.
 - .2 For steel joist: manufactured joist clamp, steel plate washer.
 - .3 For steel beams: manufactured beam clamps.

2.11 SECURITY BAR

- .1 Security bars to be installed as per drawings.
- .2 Locate in ductwork as shown on drawings, all exterior roof and wall louvers.

PART 3 EXECUTION

3.1 GENERAL

- .1 Do work in accordance with NFPA 90A and SMACNA.
- .2 Do not break continuity of insulation vapour barrier with hangers or rods.
 - .1 Insulate strap hangers 100 mm beyond insulated duct Ensure diffuser is fully seated.
- .3 Support risers in accordance with ASHRAE SMACNA as indicated.
- .4 Install breakaway joints in ductwork on sides of fire separation.
- .5 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .6 Manufacture duct in lengths and diameter to accommodate installation of acoustic duct lining.

3.2 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with ASHRAE SMACNA as follows:

Duct Size (mm)	spacing (mm)
to 1500	3000
1501 and over	2500

3.3 WATERTIGHT DUCT

- .1 Provide watertight duct for:
 - .1 Fresh air intakes including combustion air systems.
 - .2 Exhaust stacks from base of riser upwards.
 - .3 All exterior ductwork.
 - .4 And as indicated.
- .2 Form bottom of horizontal duct without longitudinal seams.
 - .1 Solder weld joints of bottom and side sheets.
 - .2 Seal other joints with duct sealer.
- .3 Fit base of riser with 150 mm deep drain sump and 32 mm drain connected, with deep seal trap and trap primer and discharging to open funnel drain.

3.4 SEALING AND TAPING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of one coat of sealant to manufacturers recommendations.

3.5 DUCT MATERIALS

- .1 Ducts shall be constructed of the following materials unless indicated otherwise.
 - .1 Interior duct systems: galvanized steel.
 - .2 Exterior duct systems and components: stainless steel.

3.6 LEAKAGE TESTS

- .1 Refer to Section 23 05 94 - Pressure Testing of Ducted Air Systems.
- .2 In accordance with SMACNA HVAC Duct Leakage Test Manual.
- .3 Do leakage tests in sections.
- .4 Make trial leakage tests as instructed to demonstrate workmanship.
- .5 Do not install additional ductwork until trial test has been passed.
- .6 Test section minimum of 30 m long with not less than three branch takeoffs and two 90 degrees elbows.
- .7 Complete test before performance insulation or concealment Work.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with section 01 74 00 - Cleaning And Waste Processing.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 Cleaning and Waste Processing.

3.8 FIELD QUALITY CONTROL

- .1 Performance Verification:
 - .1 Refer to commissioning plan.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 653/A653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM C 423-09a, Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - .3 ASTM E 90-09, Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - .4 ASTM E 477-13, Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
- .3 National Building Code (NBC)
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide separate shop drawings for each piece of attenuation equipment system shop drawings complete with product data.

1.4 PERFORMANCE RATING DATA

- .1 Provide performance rating data, certified by a professional engineer or accredited test laboratory and supported by calculations and verified by test results in accordance with referenced standards as follows:
 - .1 Silencer: insertion loss, pressure drop at design conditions, generated noise level.
 - .2 Acoustic plenums: transmission loss and acoustical absorption.
 - .3 Acoustical performance measurements to be made in accordance with ASTM E 477, ASTM E 90 and ASTM C 423, except where specified otherwise.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Provide maintenance data for incorporation into manual

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Delivery, store and handle in accordance with Section 01 61 00 - Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacture's written instructions.

PART 2 PRODUCTS

2.1 ABSORPTION AND INSULATING MEDIA

- .1 Acoustic quality, glass fibre, free of shot and odour; bacteria and fungus resistant; free of corrosion causing or accelerating agents; packed to density to meet performance requirements; and meet NBC fire requirements or requirements of authority having jurisdiction for duct lining.
- .2 Interior of plenum to be perforated sheet metal. Thickness to match exterior duct.

2.2 SILENCERS

- .1 Factory manufactured of prime coated or galvanized steel, compatible with ductwork specified elsewhere and to ASHRAE and SMACNA standards.
- .2 Outer casing and galvanized steel inner casing with clean cut circular perforations to enclose acoustic media. Inner casing to have half-splitters pods running full length of silencer where any cross sectional dimension exceeds 450 mm. Protect media from erosion with glass fibre cloth, tedlar or mylar between media and perforated metal.
- .3 Performance: Minimum dynamic insertion loss (dB) to be 19, 28, 28, 16 at 250, 500, 1000 and 2000 Hz frequency unless indicated otherwise.
- .4 Acceptable material: Vibro Acoustics ,Trane, Vibron, EH Price.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Noise flanking: where indicated, install in wall sleeve with uniform clearance around to ensure no contact of silencer with wall sleeve. Pack with flexible, non hardening caulking on both sides of sleeves.
- .3 Instrument test ports: install at inlet and outlet to permit measurement of insertion loss and pressure loss.
- .4 Suspension: to manufacturer's instructions.

3.2 TESTING

- .1 Experienced and competent sound and vibration testing professional engineer to take sound measurement after start up and testing, adjusting and balancing of systems to Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .2 Sound measurements to extend over frequency range.
- .3 In areas adjacent to mechanical equipment rooms, duct and pipe shafts.
- .4 At 1800 mm above floor adjacent to first air terminal.

- .5 Provide Departmental Representative with notice 24 h in advance of commencement of tests.
- .6 Establish adequacy of equipment isolation, acceptability of noise levels in occupied areas, other conditions affecting acoustics and, where appropriate, recommendation for remedial measures and costs.
- .7 Submit complete report of test results including sound curves.

3.3 ADJUSTING

- .1 Make adjustments and corrections in accordance with written report.
- .2 Provide Departmental Representative with notice 24 hours in advance of visit.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 32 00 - Construction Progress Documentation.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Section 01 35 23 - Health and Safety.
- .4 Section 01 45 00 - Quality Control.

1.2 REFERENCES

- .1 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .2 SMACNA - HVAC Duct Construction Standards - Metal and Flexible, 2005.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.

1.4 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Instructions: submit manufacturer's installation instructions.
- .4 Closeout Submittals: submit maintenance and engineering data for incorporation into manual specified in 01 78 10 – Closeout Submittals.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame 0.7 mm thick with fabric clenched by means of double locked seams.
- .2 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at minus 40° C to plus 90° C, density of 1.3 kg/m³.

2.3 ACCESS DOORS IN DUCTS

- .1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .3 Gaskets: neoprene or foam rubber.
- .4 Hardware:
 - .1 Up to 300 x 300 mm: two sash locks complete with safety chain.
 - .2 301 to 450 mm: four sash locks complete with safety chain.
 - .3 451 to 1000 mm: piano hinge and minimum two sash locks.
 - .4 Doors over 1000 mm: piano hinge and two handles operable from both sides.
 - .5 Hold open devices.
 - .6 300 x 300 mm glass viewing panels.

2.4 TURNING VANES

- .1 Factory or shop fabricated single thickness, to recommendations of SMACNA and as indicated.

2.5 INSTRUMENT TEST PORTS

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

2.6 CROSS TALK SILENCERS

- .1 Silencer inlet and outlet connection dimensions must be equal to the duct sizes shown on the drawings. Duct transitions at silencers are not permitted unless shown on the contract drawings.
- .2 STC-50 Rating
- .3 Silencer internal Pressure Drop 5 pascals.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.2 INSTALLATION

- .1 Flexible connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
 - .2 Length of connection: 100 mm.
 - .3 Minimum distance between metal parts when system in operation: 75 mm.
 - .4 Install in accordance with recommendations of SMACNA.

- .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .2 Access doors and viewing panels:
 - .1 Size:
 - .1 609x609 mm for person size entry.
 - .2 457x457 mm for servicing entry.
 - .3 300x300 mm for viewing.
 - .4 As indicated.
 - .2 Locations:
 - .1 Fire and smoke dampers.
 - .2 Control dampers.
 - .3 Devices requiring maintenance.
 - .4 Required by code.
 - .5 Reheat coils.
 - .6 Elsewhere as indicated.
- .3 Instrument test ports.
 - .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments.
 - .3 Install insulation port extensions as required.
 - .4 Locations.
 - .1 For traverse readings:
 - .1 Ducted inlets to roof and wall exhausters.
 - .2 Inlets and outlets of other fan systems.
 - .3 Main and sub-main ducts.
 - .4 And as indicated.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by Departmental Representative
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.
 - .5 Ensure test ports are located in enough straight duct to get an accurate reading and in accordance with ASHRAE and SMACNA guidelines.

- .4 Turning vanes:
 - .1 Install in accordance with recommendations of SMACNA and as indicated.

3.3 CLEANING

- .1 Perform cleaning operations as specified in Section 01 74 00 – Cleaning and Waste Processing, and in accordance with manufacturer's recommendations.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.4 FIELD QUALITY CONTROL:

- .1 Performance Verification:
 - .1 Refer to commissioning plan.

PART 1 GENERAL

1.1 REFERENCES

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible - 2005.

1.2 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Indicate the following:
 - .1 Pressure drop.
 - .2 Closeout Submittals: in accordance to Section 01 78 10 – Closeout Submittals.
 - .1 Provide maintenance data for incorporation into manual.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS

- .1 Of same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm as indicated.
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside nylon end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

2.3 MULTI-BLADES DAMPERS

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: 100 mm as indicated.
- .4 Bearings: pin in bronze bushings self-lubricating nylon.
- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .7 Maximum leakage: 5% at 65Pa.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install where indicated and as required for balancing of systems.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

- .3 For supply, return and exhaust systems, locate balancing dampers in each branch duct.
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 All dampers to be vibration free.
- .6 Ensure damper operators are observable and accessible.

3.2 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.3 FIELD QUALITY CONTROL

- .1 Performance Verification:
 - .1 Refer to commissioning plan.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 23 33 00 - Air Duct Accessories.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 653M-13, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
- .2 American National Standards Institute (ANSI)
 - .1 ANSI/AMCA Standard 500-D-12, Laboratory Methods of Testing Dampers for Rating.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following:
 - .1 Performance data, leakage at closed position, pressure drop, torque required.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.

1.5 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency.

PART 2 PRODUCTS

2.1 MULTI-LEAF DAMPERS

- .1 Refer to Division 25 Section 25 30 02 – EMCS: Field Control Devices.

2.2 BACKDRAFT DAMPERS

- .1 Automatic gravity operated, multi-leaf, steel spring assisted with nylon bearings, install where indicated.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.
- .3 Seal multiple damper modules with silicon sealant.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

- .5 Ensure dampers are observable and accessible.

3.2 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.3 FIELD QUALITY CONTROL

- .1 Performance Verification:
 - .1 Refer to commissioning plan.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures

1.2 REFERENCES

- .1 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
 - .1 NFPA 80: Standard for Fire Doors and Other Opening Protectives.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 CAN4-S112-M1990, Fire Test of Fire Damper Assemblies.
 - .2 CAN4-S112.2-M84, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
 - .3 ULC-S505-1974, Fusible Links for Fire Protection Service.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate the following:
 - .1 Fire dampers.
 - .2 Operators.
 - .3 Fusible links.

- .4 Design details of break-away joints.
- .2 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
- .3 Closeout Submittals:
 - .1 Provide maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.

1.4 QUALITY ASSURANCE

- .1 Certificates:
 - .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.5 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 10 - Closeout Submittals.
 - .2 Provide following:
 - .1 24 fusible links of each type.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20 - Waste Managing and Disposal.

PART 2 PRODUCTS

2.1 FIRE DAMPERS

- .1 Fire dampers: arrangement Type B or C, bear label of ULC, meet requirements of ANSI/NFPA 80A. Fire damper assemblies fire tested in accordance with CAN4-S112.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
 - .1 Fire dampers: ratings to match fire rated separation as indicated on architectural drawings. 3 hour rating required on Hangar bay wall penetrations unless indicated otherwise.
 - .2 Fire dampers: automatic operating type and have dynamic rating suitable for maximum air velocity and pressure differential to which it will be subjected.
- .3 Top hinged: offset, round or square; multi-blade hinged or interlocking type; roll door type; sized to maintain full duct cross section as indicated.
- .4 Fusible link actuated, to close and lock in closed position when released with spring-closing operator.
- .5 40 x 40 x 3 mm retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Equip fire dampers with steel sleeve or frame installed disruption ductwork or impair damper operation.
- .7 Equip sleeves or frames with perimeter mounting angles attached on both sides of wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce ceiling to conform with ULC.
- .8 Design and construct dampers to not reduce duct or air transfer opening cross-sectional area.

- .9 Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition of floor slab depth or thickness.
- .10 Unless otherwise indicated, the installation details given in SMACNA Install Fire Damp HVAC and in manufacturer's instructions for fire dampers shall be followed.
- .11 3 hour rated walls require fire dampers which are actuated by heat from either side of the wall.
- .12 Fire damper to be install where indicated on drawings and in vertical ducts that penetrate the fire separation membrane at the underside of trusses.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install in accordance with ANSI/NFPA 80A and in accordance with conditions of ULC listing.
- .2 Maintain integrity of fire separation.
- .3 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .4 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.
- .5 Co-ordinate with installer of firestopping.
- .6 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.
- .7 Install break-away joints of approved design on each side of fire separation.

3.3 TESTING

- .1 All fire damper shall be inspected and tested as per NFPA 80.
- .2 Each fire damper shall be tagged following testing, and the tag shall identify the date of testing.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.5 FIELD QUALITY CONTROL

- .1 Performance Verification:
 - .1 Refer to commissioning plan.

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation of flexible ductwork, joints and accessories.
- .2 Related Sections:
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 01 35 23 - Health and Safety.

1.2 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .2 Transportation of Dangerous Goods Act, 2008 (TDGA), c. 34.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .4 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-15, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B-15, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.
- .5 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, 2005, 3rd Edition.
 - .2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 2007, 2nd Edition.
- .6 Underwriters' Laboratories Inc. (UL).
 - .1 UL 181, Standard for Factory-Made Air Ducts and Air Connectors.

- .7 Underwriters' Laboratories of Canada (ULC).
- .1 CAN/ULC-S110-13, Fire Tests for Air Ducts.

1.3 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Closeout Submittals: in accordance to Section 01 78 10 – Closeout Submittals.
 - .1 Provide maintenance data for incorporation into manual.

1.4 QUALITY ASSURANCE

- .1 Certification of Ratings:
 - .1 Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Factory fabricated to CAN/ULC-S110-13.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.

- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 NON-METALLIC - UNINSULATED

- .1 Non-collapsible, coated mineral-based fabric type mechanically bonded to, and helically supported by, external steel wire.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.

2.3 NON-METALLIC - INSULATED

- .1 Non-collapsible, coated mineral base fabric type mechanically bonded to, and helically supported by, external steel wire with factory-applied, flexible mineral fibre thermal insulation with vapour barrier reinforced mylar/neoprene laminate jacket.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.
 - .3 thermal loss/gain: 1.31 W/m², degrees C mean.

PART 3 EXECUTION

3.1 DUCT INSTALLATION

- .1 Install in accordance with: CAN/ULC-S110-13, UL-181, NFPA 90A, NFPA 90B, SMACNA and the requirements of the jurisdictional authority.
- .2 Install insulated flex on systems requiring insulated ducting.

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for acoustic duct lining.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Quality Control.
- .3 Section 01 35 23 - Health and Safety.

1.3 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM C 423-09a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - .2 ASTM C 916-85(2007), Standard Specification for Adhesives for Duct Thermal Insulation.
 - .3 ASTM C 1071-12, Standard specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 - .4 ASTM C 1338-14, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
 - .5 ASTM G 21-09, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .3 National Fire Protection Association (NFPA).
 - .1 NFPA 90A-15, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - .2 NFPA 90B-15, Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

- .4 North American Insulation Manufacturers Association (NAIMA).
 - .1 NAIMA AH116-2002, Fibrous Glass Duct Construction Standards.
- .5 Sheet Metal and Air Conditioning Contractor's National Association (SMACNA).
 - .1 SMACNA, HVAC DCS, HVAC, Duct Construction Standards, Metal and Flexible-2005.
 - .2 SMACNA IAQ Guideline for Occupied Buildings 07.
- .6 Underwriter's Laboratories of Canada (ULC).
 - .1 CAN/ULC-S102-10-EN, Methods of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.4 SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Closeout Submittals: in accordance to Section 01 78 10 – Closeout Submittals.
 - .1 Provide maintenance data for incorporation into manual.

1.5 HEALTH AND SAFETY

- .1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Protect on site stored or installed absorptive material from moisture damage.

PART 2 PRODUCTS

2.1 DUCT LINER

.1 General:

- .1 Mineral Fibre duct liner: air surface coated mat facing.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50 when tested in accordance with CAN/ULC-S102-10, NFPA 90A and NFPA 90B.
- .3 Fungi resistance: to ASTM C 1338 and ASTM G 21.

.2 Rigid: Use on flat surfaces where indicated

- .1 25 mm thick, to ASTM C1071-12, Type 2, fibrous glass rigid board duct liner.
- .2 Density: 48 kg/m² minimum.
- .3 Thermal resistance to be minimum 0.76 (m³.degrees C)/W for 25 mm thickness 1.15 (m³.degrees C)/W for 38 mm thickness 1.53 (m³.degrees C)/W for 50 mm thickness when tested in accordance with ASTM C 177-13, at 24 degrees C mean temperature.
- .4 Maximum velocity on faced air side: 20.3 m/sec.
- .5 Minimum NRC of 0.70 at 25 mm thickness based on Type A mounting to ASTM C 423-09a.

.3 Flexible:

- .1 Use where indicated.
- .2 25 mm thick, to ASTM C 1071-12 Type 1, fibrous glass blanket duct liner.
- .3 Density: 24 kg/m² minimum.
- .4 Thermal resistance to be minimum 0.37 (m³.degrees C)/W for 12 mm thickness 0.74 (m³.degrees C)/W for 25 mm thickness 1.11 (m³.degrees C)/W for 38 mm thickness 1.41 (m³.degrees C)/W to 50 mm thickness when tested in accordance with ASTM C 177, at 24 degrees C mean temperature.
- .5 Maximum velocity on coated air side: 25.4 m/sec.
- .6 Minimum NRC of 0.65 at 25 mm thickness based on Type A mounting to ASTM C 423-09a.

2.2 ADHESIVE

- .1 Adhesive: to appropriate Regional and Municipal Code.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 40 degrees C to plus 93 degrees C.
- .3 Water-based fire retardant type.

2.3 FASTENERS

- .1 Weld pins 2.0 mm diameter, length to suit thickness of insulation. Polymer, Nylon, or Metal retaining clips, 32 mm square.

2.4 JOINT TAPE

- .1 Poly-Vinyl treated open weave fiberglass membrane 50 mm wide.

2.5 SEALER

- .1 Meet requirements of NFPA 90A and NFPA 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range minus 68 degrees C to plus 93 degrees C.

PART 3 EXECUTION

3.1 GENERAL

- .1 Do work in accordance with SMACNA HVAC DCS, NAIMA Fibrous Glass Duct Construction Standards and as indicated except as specified otherwise.
- .2 Line inside of ducts where indicated.
- .3 Duct dimensions, as indicated, are clear inside duct lining.

3.2 DUCT LINER

- .1 Install in accordance with manufacturer's recommendations, and as follows:
 - .1 Fasten to interior sheet metal surface with 90% coverage of adhesive to ASTM C 916-85(2007).
 - .1 Exposed leading edges and transverse joints to be factory coated or coated with adhesive during fabrication.
 - .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 425 mm on centres and impact driven mechanical fasteners to compress duct liner sufficiently to hold it firmly in place.
 - .1 Spacing of mechanical fasteners in accordance with SMAC HVAC DCS and NAIMA AH116.
 - .2 Install galvanized sheet metal nosing to leading edges of duct liner.

3.3 JOINTS

- .1 Seal butt joints, exposed edges, weld pin and clip penetrations and damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's written recommendations, and as follows:
 - .1 Bed tape in sealer.
 - .2 Apply two coats of sealer over tape.
- .2 Replace damaged areas of liner at discretion of Departmental Representative.
- .3 Protect leading and trailing edges of duct sections with sheet metal nosing having 15 mm overlap and fastened to duct.

3.4 OPERATION REQUIREMENTS

- .1 Operational requirements, include:
 - .1 Cleaning materials and schedules.
 - .2 Repair and maintenance materials and instructions.
 - .3 Spare parts if any are recommended by equipment manufacturer.

3.5 FIELD QUALITY CONTROL

- .1 Performance Verification:
 - .1 Refer to commissioning plan.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- .2 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .3 Section 23 33 00 - Air Duct Accessories.

1.2 REFERENCES

- .1 AMCA 99-2010, Standards Handbook.
- .2 AMCA 300-08, Reverberant Room Method for Sound Testing of Fans.
- .3 AMCA 301-07, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .4 ANSI/ASHRAE 51-2007/AMCA 210-07, Laboratory Methods of Testing Fans for Rating.
- .5 CAN/CGSB-1.181-99, Coating, Zinc Rich, Organic, Ready Mixed.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide:
 - .1 Fan performance curves showing point of operation, BHP, kW and efficiency.
 - .2 Sound rating data at point of operation.
- .3 Indicate:
 - .1 Motors, sheaves, bearings, shaft details
 - .2 Minimum performance achievable with variable speed controllers and variable inlet vanes as appropriate.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for incorporation into manual specified in 01 78 10 – Closeout Submittals.

1.5 EXTRA MATERIALS

- .1 Provide maintenance materials.
 - .1 Spare parts to include:
 - .1 Matched sets of belts.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.6 MANUFACTURED ITEMS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

PART 2 PRODUCTS

2.1 FANS GENERAL

- .1 Capacity: flow rate, total static pressure, W, efficiency, revolutions per minute, power, model, size, and sound power data as indicated on schedule.
- .2 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.
- .3 Sound ratings: comply with AMCA 301-07, tested to AMCA 300-08. Unit shall bear AMCA certified sound rating seal.
- .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210-07, and ANSI/ASHRAE 51-2007/AMCA 210-07. Unit shall bear AMCA certified rating seal, except for propeller fans smaller than 300 mm diameter.
- .5 Motors:
 - .1 In accordance with Section 23 05 13 - Common Motors Requirements for HVAC Equipment supplemented as specified herein.
 - .2 For use with variable speed controllers where specified.
 - .3 Sizes as indicated.
 - .4 Two speed with two windings and speeds as indicated.
 - .5 Two speed with split winding, constant horsepower constant or variable torque and speeds of r/min as indicated.
- .6 Accessories and hardware: matched sets of V-belt drives, adjustable slide rail motor bases, belt guards, coupling guards fan inlet safety screens as indicated and as specified in Section 23 05 13 - Common Motor Requirements for HVAC Equipment. Inlet outlet dampers and vanes and as indicated.
- .7 Factory primed before assembly in colour standard to manufacturer.
- .8 Provide scroll casing drains.
- .9 Bearing lubrication systems plus extension lubrication tubes where bearings are not easily accessible.
- .10 Vibration isolation: to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
- .11 Flexible connections: to Section 23 33 00 - Air Duct Accessories.

2.2 IN-LINE CENTRIFUGAL FANS

- .1 Fan wheels: Characteristics and construction:
 - .1 Welded steel construction.
 - .2 Maximum operating speed of centrifugal fans not more than 40% of first critical speed.
 - .3 Forward curved blades.
- .2 Provide AMCA arrangements 1 or 9 as indicated with stiffened flanges, smooth rounded inlets, and stationary guide vanes.
- .3 Bearings: split pillow-block flange mounted grease lubricated ball or roller self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 200,000 hours.
- .4 Housings:
 - .1 Volute with inlet cones: fabricated steel for wheels 300 mm or greater, and with welded supports.
 - .2 For horizontally and vertically split housings provide flanges on each section for bolting together, with gaskets of non-oxidizing non-flammable material.
 - .3 Provide bolted airtight access doors with handles.
- .5 Acceptable material: Trane, York, Greenheck, Woods, Penn, Cook.

PART 3 EXECUTION

3.1 FAN INSTALLATION

- .1 Install fans as indicated, complete with resilient mountings and seismic controls as specified in Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment, flexible electrical leads and flexible connections in accordance with Section 23 33 00 - Air Duct Accessories.
- .2 Provide sheaves and belts required for final air balance.
- .3 Bearings and extension tubes to be easily accessible.
- .4 Access doors and access panels to be easily accessible.
- .5 Size anchor bolts to withstand seismic acceleration and velocity forces.

- .6 Arrange connecting duct work to follow manufacturer's recommendation regarding proper air flow patterns entering and exiting unit to avoid system fan effects.

3.2 FIELD QUALITY CONTROL

- .1 Performance Verification:
 - .1 Refer to commissioning plan.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 23 05 13 - Common Motor Requirements for HVAC Equipment.
- .3 Section 23 33 15 - Dampers - Operating.

1.2 REFERENCES

- .1 Air Moving and Conditioning Association (AMCA)
 - .1 AMCA 99, Standards Handbook.
 - .2 AMCA 300-08, Reverberant Room Method for Sound Testing of Fans.
 - .3 AMCA 301-07, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .2 American National Standards Institute (ANSI)
 - .1 ANSI/ASHRAE 51/AMCA 210-07, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Include:
 - .1 Fan performance curves showing specified point of operation.
 - .2 Sound rating data.
 - .3 Electrical requirements including wiring diagrams for interlock and control wiring.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Provide maintenance data for incorporation into manual

1.5 CERTIFICATIONS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.
- .2 Provide confirmation of testing.

1.6 EXTRA MATERIALS

- .1 Provide maintenance materials.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.
- .3 Include manufacturer's installation instructions.

PART 2 PRODUCTS

2.1 FANS GENERAL

- .1 Capacity: flow rate, static pressure Pa, r/min, Wattage, and sound ratings as indicated on schedule.
- .2 Statically and dynamically balanced. Constructed in conformity with AMCA 99.
- .3 Sound ratings: comply with AMCA 301-06, tested to AMCA 300-08. Unit shall bear AMCA certified sound rating seal.

- .4 Performance ratings: based on tests performed in accordance with ANSI/ASHRAE 51/AMCA 210, unit to bear AMCA certified rating seal.
- .5 Bearings: Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum catalogued operating speeds.

2.2 ROOF EXHAUSTERS

- .1 Roof exhausters shall be centrifugal, spun aluminum belt driven type.
 - .1 The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone matched to the inlet cone for precise running tolerances.
 - .2 Wheels shall be statically and dynamically balanced.
 - .3 A disconnect switch shall be provided within fan housing.
 - .4 The fan housing shall be uniquely spun from a cylinder of heavy gauge aluminum and mounted to a high strength steel frame.
 - .5 The windband shall be 100% continuously welded to the one-piece aluminum curb cap. High wind load braces shall connect the curb cap to the windband.
- .2 Motors and Drives
 - .1 Motors shall be heavy-duty permanently lubricated type, matched to the fan load, and furnished mounted to the steel drive frame at the specified voltage, phase, and enclosure as shown on the schedule and drawings. Refer to Section 23 05 13 - Common Motor requirement for HVAC Equipment.
 - .2 Motors and drives shall be mounted on vibration isolators and have seismic restraints in accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.
 - .3 Motors and drives shall be readily accessible for maintenance.
 - .4 Drives shall be sized for a minimum of 150% of driven horsepower.
 - .5 Pulleys shall be of the cast type, keyed and securely attached to the wheel and motor shafts.
 - .6 Motor pulleys shall be adjusted for final system balancing.
 - .7 Provide OSHA motor/fan guard for all fans.
- .3 Accessories:
 - .1 Insulated Roof Curbs: 400 mm high curbs of same manufacturer as fan and built to suit model specified.
 - .2 Other accessories as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions and in accordance with section 23 05 48 Vibration and Seismic controls for HVAC piping and equipment

3.2 ANCHOR BOLTS AND TEMPLATES

- .1 Size anchor bolts to withstand seismic acceleration and velocity forces as specified in section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

3.3 FIELD QUALITY CONTROL

- .1 Performance Verification:
 - .1 Refer to commissioning plan.

PART 1 GENERAL

1.1 REGULATORY REQUIREMENTS

- .1 Comply with federal, provincial, and local anti-pollution laws, ordinances, codes and regulations when handling, transporting and disposing of materials.

1.2 GENERAL SPECIFICATIONS

- .1 The Contractor shall confirm all field conditions as well as dimensions and positions indicated on plans and notify Departmental Representative of any conflicts with plans before proceeding with work.
- .2 The Contractor shall follow the manufacturer's instructions and specifications for installation and use of all materials and equipment.
- .3 The Contract shall install the vapour exhaust system in accordance with the Contract Drawings.
- .4 Sampling and analysis of gases and vapors being handled by this system, both within the vent system itself and within occupied interior building space, shall be done by person(s) licensed and certified for such sampling and analysis. Sampling shall be done per all Provincial and Federal requirements. Such sampling and analysis thereof shall determine if an active, fan-driven system is to be employed, as well as the type of exhaust fan unit to be used.

1.3 LABELLING

- .1 A system description label shall be placed on the mitigation system and the electrical service entrance panel.
 - .1 Circuit breakers controlling the circuits on which the exhaust fan devices operate shall be labeled "Vapour Exhaust System".

- .2 All exposed and visible interior system vent pipe sections shall be identified with at least one label on each floor level. The label shall read: "Vapour Exhaust System". Labeling shall be legible from a distance of at least 1 meter and include the following information.
 - .1 Vapour Exhaust System.
 - .2 Installer's name and phone number.
 - .3 Date of installation.
 - .4 An advisory that the building should be tested for volatile organic vapours at least once a year or as required or recommended by Departmental Representative.

1.4 EXHAUST FAN (IF REQUIRED)

- .1 Unit(s) to be sealed, in-line duct style rated for outdoor use.
- .2 Located so as to be accessible for installation, maintenance, and future replacement.
- .3 Installed in a vertical run of vent pipe.
- .4 Mounted and secured in a manner that minimizes transfer of vibration to the structural framing of the building.
- .5 Attached to vent piping with "Fernco" type connectors.
- .6 Have an electrical disconnect within sight of fan unit.
- .7 Appropriate fan locations: Unoccupied attic; Outside building; Garage not having occupied space above.
- .8 The size and air movement capacity of the exhaust fan, and number of fans used, shall be sufficient to create and maintain a pressure field beneath the slab that is lower than the pressure above the slab or membrane.
- .9 Fan unit(s) shall be designed or otherwise sealed to reduce the potential for leakage of soil gas/vapor from the fan housing.
- .10 Even if an exhaust fan(s) not be required or initially installed, all locations for possible fan installations noted on plans must.

- .1 Be as close as possible to the vents exit point from the building, or outside the building shell.
- .2 Allow the fan and downstream piping to be isolated from the indoor air.
- .3 Be supplied with a junction box with a 110 volt power supply.

1.5 CONCRETE SLAB

- .1 All concrete slabs that come in contact with the ground shall be laid over a gas permeable material made up of a uniform layer of clean aggregate.
- .2 Seal all joints or penetrations in slab or other floor systems and below-grade walls, which will not be accessible at time of final inspection.
- .3 Stub-outs to be provided so as to connect with vent system above and below slab.

1.6 SOIL GAS RETARDER MEMBRANE

- .1 Soil Gas Retarder Membrane: Unless otherwise noted or approved, a soil-gas-retarder (vapor-barrier) membrane between the slab substrate and the concrete slab itself as per the following:
 - .1 Membrane should be equivalent, or exceed in quality, 2-ply, cross-laminated poly plastic sheeting equal to a 20 mil thickness.
 - .2 Overlap all seams a minimum of 300 mm.
 - .3 Seam laps and edges to be continuously caulked and/or taped with a product that will adhere to the poly sheeting and stay flexible.
 - .4 Seal all penetrations through the plastic sheeting.

1.7 SEALING

- .1 All opening, gaps, and joints in floor and wall assemblies in contact soil or gaps around pipes, toilets, or drains penetrating these assemblies shall be filled or closed with materials that provide a permanent air-tight seal.

- .2 Seal large openings with non-shrink mortar, grouts, or expanding foam materials and smaller gaps with an elastomeric joint sealant, as defined in ASTM C920-14.
- .3 Sealants must be approved by the manufacturer for the intended use.
- .4 Placement and tooling must be in accordance with manufacturer's specifications and result in no gaps or voids after curing.
- .5 See "Soil Gas Retarder Membrane".

1.8 VENTING

- .1 One continuous, sealed vent pipe shall run from a sealed connection to the sub-slab perforated pipe system within the aggregate to a point outside the building.
- .2 Vent pipes shall be installed so that any rainwater or condensation drains downward into the ground beneath the slab or soil gas retarder membrane.
- .3 Vent piping to be 100 mm diameter PVC or ABS, schedule 40 or approved equivalent.
- .4 All pipe joints and connections to be permanently sealed with adhesives as specified by the manufacturer of the pipe material so as to be gas tight. (See "Exhaust Fans" above for exception when installing fan units).
- .5 Point of exhaust venting discharge shall meet all of the following requirements:
 - .1 Be a minimum of 100 cm (1 meter) above the roofline.
 - .2 Be 300 cm (3 meters) or more above ground level.
 - .3 Be 300 cm (3 meters) or more from any operable window, chimney, door, or other openings into conditioned spaces of building.
 - .4 Be 300 cm (3 meters) or more from any opening into an adjacent building.
 - .5 The total required distance (300 cm) from the point of discharge to openings in the structure may be measured either directly between the two points or be the sum of measurements made around intervening obstacles.
 - .6 The exhaust point should be positioned above the highest eave of the building.

- .7 The initial installation is to be a passive system (Exhaust Fan Upgrade not used), the vent pipe terminations shall be capped with a inverted siphon or rotary/turbine vent cap or equivalent.
- .8 Should this installation require pipes to penetrate a firewall or other fire resistance rated wall or floor, penetrations shall be protected in accordance with applicable building, mechanical, and electrical codes.
- .9 Vent pipes shall be fastened to the structure of the building with hangers, strapping, or other supports that will adequately secure the vent pipe material. To prevent blockage of air flow into the bottom of vent pipes, these pipes shall be supported or secured in a permanent manner that prevents their downward movement into the soil beneath aggregate layer under the slab, or deforms and or blocks any sub-slab vent piping.
- .10 Vent piping shall be within the buildings thermal envelope.
- .11 See "Sub-Slab Perforated Pipe".

1.9 SUB-SLAB PERFORATED PIPE

- .1 Any perforated pipe utilized in a sub-slab/sub-membrane portion of the mitigation vent system shall be installed as per the following:
 - .1 100 mm diameter (minimum) schedule 40 perforated PVC to ASTM D1785. 2 rows of holes, 120° apart, parallel to the axis of the pipe. Holes to be 12.7mm diameter, spaced 127mm apart on center. Drill additional 12.7mm holes in bottom of pipe at 2m spacing along the entire length of pipes to allow for drainage of any liquids which may enter pipe.
 - .2 Covered with a geotextile cloth if fines not removed from surrounding aggregate fill.
 - .3 Any thru-slab riser stub-outs shall be non perforated Schedule 40 ABS or PVC, or approved equivalent.
 - .4 Thru-slab riser sub-outs to be labeled "Vapour Exhaust Pipe".
 - .5 Perforated pipe shall be solidly connected and sealed to thru-slab risers via a 100 mm (minimum) Schedule 40 ABS or PVC TEE, or approved equivalent.
 - .6 Perforated pipe sections shall pass through interior footings, grade-beams, or other barriers via a non-perforated protective sleeve.

PART 2 PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 EXECUTION

3.1 NOT USED

.1 Not used.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 20 - Waste Managing and Disposal.
- .3 Section 01 78 10 - Closeout Procedures.
- .4 Section 01 45 00 - Quality Control.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI/ASHRAE 51-2007 / AMCA 210-07, Laboratory Methods of Testing Fans for Rating.
 - .2 ANSI/NFPA 90A-2009, Installation of Air Conditioning and Ventilating Systems.
- .2 International Organization of Standardization (ISO)
 - .1 ISO 3741-2001, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.
- .3 Underwriter's Laboratories (UL)
- .4 UL 181, Factory-Made Air Ducts and Air Connectors.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following:
 - .1 Capacity.
 - .2 Pressure drop.
 - .3 Noise rating.
 - .4 Leakage.

1.4 TEST REPORTS

- .1 To ANSI/ASHRAE 51-2007 / AMCA 210-07. Submit published test data on DIN (Direct Internal Noise), in accordance with ISO 3741 made by independent testing agency for 0, 2.5 and 6 m/s branch velocity or inlet velocity. Sound power level with minimum inlet pressure of 0.25 0.5 1 1.5 kPa in accordance with ISO 3741 for 2nd through 7th octave band, also made by independent testing agency. Pressure loss through silencer shall not exceed 60% of inlet velocity pressure maximum.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Procedures.

1.6 CERTIFICATION

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

1.7 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 10 - Closeout Procedures.
- .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

- .1 Terminal units of the same type to be product of one manufacturer.

2.2 FAN POWERED MIXING BOX WITH ELECTRIC REHEAT

- .1 Pressure independent, reset to air flow between zero and maximum air volume.
- .2 Factory assembled component to form units supply air and heat at designed conditions, as indicated.
- .3 Horizontal type consisting of casing, motorized damper, fan section with motor and drive and electric heating coil. Electric reheat coil to be SCR controlled.
- .4 At inlet velocity of 10 m/s, differential static pressure for unit with attenuator section not to exceed 25 Pa.
- .5 Sound ratings of assembly not to exceed 27 NC at 375 Pa.
- .6 Multipoint cross shaped flow sensor with amplifying pressure pickup points located at inlet of box.
- .7 FVAV box controller to be a native BACnet controller as per ASHRAE Standard 135 and in accordance with Section 25 30 01 – EMCS: Building Controllers for full integration to division 25 EMCS. Controller to have integral feedback on damper position. Coordinate provision of controller with Division 25.
- .8 Electronic control package to be calibrated and set at factory. Features to accommodate field calibration and readjustment of air volume settings to include:
 - .1 Metre taps for balancing with digital DC voltmeter.
 - .2 Adjustable flow settings at thermostat.
- .9 Factory installed 20 VA transformer, 115 V to 24 V. Power consumption of terminal not to exceed 15 VA.
- .10 Terminal unit to be CSA certified.
- .11 Casing: constructed of 0.8 mm thick galvanized steel, internally lined with 25 mm. 0.7 kg density fibrous glass, to UL 181 and ANSI/NFPA 90A, foil faced liner. Mount control components inside protective metal shroud.

- .12 Damper: Heavy gauge thick steel with peripheral gasket and self lubricating bearings. Air leakage past closed damper not to exceed 2% of nominal rating at 750 Pa inlet static pressure, in accordance with Air Diffusion Council test procedure.
- .13 FAN BLOWER & MOTOR:
 - .1 Fan Blower shall be constructed of steel with forward curved blades, dynamically balanced wheels and directly coupled to ECM motor.
 - .2 ECM Motor: Motors shall be DC brushless motors complete with and operated by a single phase controller/inverter. Motor rotor shall be permanent magnet type with near zero rotor loss. Motor shall be permanently lubricated with ball bearing. Motor shall maintain a minimum of 70% efficiency over its entire operating range.
 - .3 Speed control shall accept as standard a (0-10VDC) (0-20mA) single for remote fan adjustment from EMCS. Speed control shall initially be field set to run at constant speed.
- .14 Complete with:
 - .1 Operator and controller: as specified.
 - .2 Sound attenuator: Minimum 900 mm long. Constructed as per casing.
 - .3 Multiport outlet adapter: as indicated.
 - .4 Reheat coil: as indicated.
- .15 Sizes and capacity: as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturers recommendations.
- .2 Support independently of ductwork.
- .3 Install with minimum of four duct diameters of straight inlet duct, same size as inlet.
- .4 Locate so that controls, dampers and access panels are easily accessible.

3.2 FIELD QUALITY CONTROL

.1 Performance Verification:

.1 Refer to commissioning plan.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.

1.3 CERTIFICATIONS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing, agency signifying adherence to codes and standards.

1.4 EXTRA MATERIALS

- .1 Provide maintenance.
- .2 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 Closeout Submittals.
- .2 Provide maintenance data for incorporation into manual.

PART 2 PRODUCTS

2.1 GENERAL

- .1 To meet capacity, pressure drop 12 to 20 Pa, terminal velocity, throw, noise level NC 25 to 38, neck velocity as indicated.
- .2 Frames:
 - .1 Full perimeter gaskets.
 - .2 Concealed fasteners.
- .3 Concealed manual volume control damper operators.
- .4 Colour: White Finish.
- .5 Acceptable material: Nailor, EH Price, Titus.

2.2 MANUFACTURED UNITS

- .1 Grilles, registers and diffusers of same generic type to be product of one manufacturer.

2.3 LOUVERED RETURN GRILLES

- .1 General: Fixed louvers, 45° deflection
- .2 Steel, 19 mm louver spacing. Finish: white enamel.

- .3 Specific Size and type: as indicated.

2.4 SUPPLY GRILLES

- .1 General: Drywall wall mounted, linear slot arrangement 180° degree air pattern control.
- .2 Aluminum Finish: white powder Coat.
- .3 Specific size and type: as indicated.

2.5 SUPPLY DIFFUSERS

- .1 General: Lay-in ceiling mounted, linear slot arrangement, 180 deg air pattern control.
- .2 Aluminum. Finish: white powder coat.
- .3 Plenum: zinc coated steel construction, sloped shoulder and side inlet as per drawings.
- .4 Specific size and type: as indicated.

2.6 SECURITY GRILLES

- .1 Welded, heavy gauge steel, 5 mm steel lattice face plate and backer plate, continuously welded sleeve, protective screen between face and backer plate.
- .2 Welded: heavy gauge steel, 6.25mm wall thickness, 1.5mm perforated lattice plate.
- .3 Acceptable Material: Chubb OP-20V, Simpson V-2, Eneround Security Type Ventilating grille, Virtucom SCO security.

2.7 TRANSFER GRILLES AND DOOR GRILLES

- .1 50% free area, sight proof design, heavy gauge extruded aluminum.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install in accordance with manufacturers' instructions.
- .2 Install non-secure devices with flat head stainless steel screws in countersunk holes where fastenings are visible, colour to match.
- .3 Install hard elbows at all right angle flex duct connections to grilles and diffusers.

3.2 FIELD QUALITY CONTROL

- .1 Performance Verification:
 - .1 Refer to commissioning plan.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)
 - .1 ANSI/NFPA 96-14, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM E 90-09, Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .3 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .4 Society of Automotive Engineers (SAE)

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate the following:
 - .1 Pressure drop.
 - .2 Face area.
 - .3 Free area.

1.4 TEST REPORTS

- .1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E 90-09.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Provide maintenance data for incorporation into manual

1.6 CERTIFICATION OF RATINGS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

PART 2 PRODUCTS

2.1 FIXED LOUVRES - ALUMINUM

- .1 Construction: welded with exposed joints ground flush and smooth.
- .2 Material: extruded aluminum alloy 6063-T5.
- .3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm.
- .4 Frame, head, sill and jamb: 150 mm deep one piece extruded aluminum, minimum 3 mm thick with approved caulking slot, integral to unit. Flanged.
- .5 Mullions: at 1500 mm maximum centres.
- .6 Fastenings: stainless steel (Society of Automotive Engineers) SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .7 Screen: 12 mm exhaust 19 mm intake mesh, 2 mm diam wire aluminum birdscreen on inside face of louvres in formed U-frame.
- .8 Finish: factory applied baked enamel 50% Polyvinylidene Fluoride (PVDF), colour to suit.
- .9 Acceptable material:
 - .1 Aerolite.
 - .2 Ruskin.

- .3 Ventex.
- .4 Price.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 In accordance with manufacturer's and SMACNA recommendations.
- .2 Reinforce and brace as indicated.
- .3 Anchor securely into opening. Seal with caulking around to ensure weather tightness provide vandalproof fasteners.
- .4 Louver flange to fit in throat of curtainwall assembly as indicated on the drawings. Contractor to coordinate.

3.2 FIELD QUALITY CONTROL

- .1 Performance Verification:
 - .1 Refer to commissioning plan.

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Filters and filter gauges for various types of mechanical air handling equipment.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 52.1-1992, Gravimetric And Dust Spot for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter (ANSI Approved).
- .2 Canadian General Standards Board (CGSB).
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 Underwriters' Laboratories of Canada
 - .1 ULC -S111-13, Standard Method of Fire Tests for Air Filter Units.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Closeout Submittals: in accordance to Section 01 78 10 – Closeout Submittals.
 - .1 Provide maintenance data for incorporation into manual.

1.4 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

1.6 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.
 - .3 Spare filters: in addition to filters installed immediately prior to acceptance by Departmental Representative, supply 1 complete set of filters for each filter unit or filter.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Media: suitable for air at 100% RH and air temperatures between minus 40 and 50 degrees C.
- .2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as required and as indicated.
- .3 Pressure drop when clean and dirty, maximum 62 Pa clean and 200 Pa dirty, sizes and thickness: as indicated on schedule.

- .4 Standardize filter size on 609 x 609 modules.

2.2 ACCESSORIES

- .1 Holding frames: permanent "T" section, same material as casing/hood, 1.6 mm thick, except where specified.
- .2 Seals: to ensure leakproof operation.
- .3 Blank-off plates: as required, to fit all openings and of same material as holding frames.
- .4 Access and servicing: through doors/panels on each side and/or downstream face of filter bank.

2.3 FIBROUS GLASS PANEL FILTERS

- .1 Disposable fibrous glass media: to CAN/CGSB-115.10 with adhesive.
- .2 Holding frame: 1.2 mm minimum thick galvanized steel with 3 mm diameter hinged wire mesh screen.
 - .1 On air handlers, by air handling unit manufacturer.
- .3 Performance:
 - .1 MERV 8 to ASHRAE 52.2.
- .4 Fire rated: to ULC -S111.
- .5 Nominal thickness: 50 mm.

2.4 CARTRIDGE TYPE FILTERS

- .1 Media: deep pleated, disposable, high efficiency, to CAN/CGSB-115.14.
- .2 Holding frame : galvanized steel with bracing.
 - .1 For air handlers, by air handler manufacturer.
- .3 Media support: welded wire grid.

- .4 Performance:
 - .1 MERV 13 to ASHRAE 52.2.
- .5 Fire rated: to ULC -S111.

2.5 FILTER GAUGES - DIAL TYPE

- .1 Diaphragm actuated, direct reading.
- .2 Range: 0 to 2 times initial pressure.
- .3 Indicate clean/dirty filter range.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION GENERAL

- .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.3 REPLACEMENT MEDIA

- .1 Replace media with new upon acceptance.
- .2 Filter media new and clean, as indicated by pressure gauge, at time of acceptance.

3.4 FILTER GAUGES

- .1 Install type as indicated across each filter bank (pre-filter and final filter) in approved and easy readable location.
- .2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

3.5 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 20 – Waste Managing and Disposal.
- .3 Section 01 78 10 – Closeout Submittals

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.46-2013, Electric Air-Heaters.

1.3 PROJECT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data sheets for duct heaters. Include:
 - .1 Product characteristics.
 - .2 Performance criteria.
 - .3 Mounting methods.
 - .4 Physical size.
 - .5 kW rating, voltage, phase.
 - .6 Limitations.
- .3 Submit WHMIS MSDS - Material Safety Data Sheets. WHMIS acceptable to Labour Canada, and Health Canada.
- .4 Submit product data sheets for unit heaters.
 - .1 Include product characteristics, performance criteria, physical size, limitations and finish.

- .5 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for unit heaters for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20 - Waste Managing and Disposal, and with Waste Reduction Workplan.

PART 2 PRODUCTS

2.1 ELECTRIC DUCT HEATERS

- .1 Modulating duct heater.
 - .1 Coils: High grade nickel-chrome alloy, insulated from galvanized steel frame by floating ceramic bushings. Coil terminal pins to be stainless steel, insulated by non-rotating ceramic bushings.
 - .2 Slip-in type heater, suitable for insertion into duct through an opening on the side. Heater will come complete with flange for securing it to the duct. Mounting flange shall be independent of the terminal box so as to allow installation without opening the box or drilling into it.
 - .3 Heaters to be complete with fail safe, automatic reset disc-type thermal cut-outs as required by CSA.
 - .4 Duct heater shall be complete with a built-in disconnect to switch power off at the unit.
 - .5 Duct heaters shall be complete with disconnecting back-up magnetic contactors, 24 volt transformer, airflow sensor, SCR control, load fuses, solid state relays, pilot lights and protective screens required to provide a consistent air temperature output.
 - .6 Cut-outs shall be shielded from accidental impact and shall de-energize the heater in case of insufficient airflow.

.7 Capacities and sizes as indicated on drawings.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install heaters in ductwork, as indicated.
- .2 Make power and control connections.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results – For Electrical.
- .2 Test cut-out protection when air movement is obstructed.
- .3 Test fan delay switch to assure dissipation of heat after element shut down.
- .4 Test unit cut-off when fan motor overload protection has operated.
- .5 Ensure heaters and controls operate correctly.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 25 90 01 - Site Requirements, Applications and System Sequences of Operation.

1.2 REFERENCES

- .1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ANSI/ASHRAE 84-2013, Method of Testing Air-to-Air Heat Energy Exchangers.
- .2 Air Conditioning and Refrigeration Institute (ARI)
 - .1 ARI-1060-2005 Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Heat Equipment.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
 - .2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate following: efficiencies, pressure loss, performance.

- .3 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions.
- .4 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals
- .5 Certificates:
 - .1 Catalogued or published ratings: obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.
 - .2 Provide confirmation of testing.

1.4 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with manufacturer's written instructions and Section 01 61 00 - Product Requirements.
- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20 - Waste Managing and Disposal.

1.5 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 01 78 10 - Closeout Submittals.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment include:
 - .1 Filters.
 - .2 Addresses of suppliers.
 - .3 List of specialized tools necessary for adjusting, repairing or replacing.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Comply with ASHRAE 84.

2.2 ENERGY RECOVERY VENTILATOR (ERV-1, ERV-2 & ERV-3)

- .1 General: packaged air-to-air energy recovery ventilator complete with fans, controllers, filters, sensors, and controls and factory wiring.
- .2 Casing: 20 gauges galvanized steel. Foil faced insulating liner. Flanged connections for ductwork.
- .3 Heat transfer surfaces: hydroscopic resin plates edge sealed and bonded to casing. Energy recovery core to allow both sensible and latent energy transfer. Core not to exceed 25/50 flame and smoke spread per NFPA 90 A and B.
- .4 Cross contamination: not permitted.
- .5 No condensation shall be generated during operation down to -23°C. For colder temperatures the unit shall prevent frosting or condensation build-up through automatic intermittent fan operation.
- .6 Removable access panels.
- .7 Filtration: MERV 8 rated, 50 mm pleated disposable on both air streams. Provide dial type filter gauges on both filter sections to Section 23 44 00 - HVAC Air Filtration.
- .8 Accessories:
 - .1 Individual contactors to allow independent operation of supply and exhaust fans for frost protection control.
 - .2 Provide sensors for frost detection and integral frost controller.
 - .3 Provide contacts for the following EMCS tie-ins for ERV-1 & ERV-2:
 - .1 On/Off Control
 - .2 Fan Amperage (via current sensing relay)
 - .3 Common Alarm
 - .4 Configured for single point power connection with integral controls transformer for low voltage circuits.
 - .5 Non-fused disconnect.

- .9 Fans: direct driven.
- .10 Performance characteristics: as indicated.
- .11 Acceptable material: Renew Aire, Lossnay, Engineered Air.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install in accordance with manufacturers recommendations.
- .2 Support independently of adjacent ductwork with flexible connections.
- .3 Install access doors in accordance with Section 23 33 00 - Air Duct Accessories for access to coils, dampers.

3.3 FIELD QUALITY CONTROL

- .1 Tests:
 - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - for Electrical.
- .2 Performance Verification:
 - .1 Refer to Commissioning Plan.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping Equipment.
- .3 Section 23 23 00 - Copper Tubing and Fittings, Refrigerant.
- .4 Section 23 33 00 - Air Duct Accessories.
- .5 Section 23 33 15 - Dampers - Operating.
- .6 Section 23 44 00 - HVAC Air Filtration.
- .7 Section 25 30 02 - EMCS: Field Control Devices.

1.2 REFERENCES

- .1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
 - .1 ANSI/AHRI 430-2009, Central Station Air Handling Units.
 - .2 ARI 260-2001 for inlet and discharge sound power levels.
 - .3 ANSI/ARI 410-2001 for capacities, pressure drops, and selection procedures of aircoils.
- .2 American Society of Heating, Refrigeration and Air Condition Engineers (ASHRAE)
 - .1 ANSI/ASHRAE 90.1-2007, (I-P) Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .2 ANSI/ASHRAE 52.2-2007, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- .3 ETL Standards.
- .4 Air movement and Control Association International, Inc. AMCA 210-07 for fan performance rating.

- .5 Air handling units will be ISO 9001 certified.
- .6 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-11-07, Environmental Standard for Paints.
- .7 Master Painters Institute (MPI)
 - .1 MPI-INT 5.3-2007, Galvanized Metal.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate following: casing construction, fans, drain pans, wiring diagrams, fan curves showing point of operation, motor drive, bearings, filters including pressure drops, mixing box dampers, coil include performance data, weight and dimensions.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Provide maintenance data for incorporation into manual.
- .3 Include following: all performance data.

1.5 EXTRA MATERIALS

- .1 Provide maintenance materials.
- .2 Spare filters: in addition to filters installed immediately prior to acceptance by Departmental Representative, supply 1 complete set of filters for each filter unit or filter bank.
- .3 Provide list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of

specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.7 CAPACITIES

- .1 Airflows indicated are to be the actual quantities for supply air from the units and return to the units.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Factory assembled components to form units supplying air at designed conditions, as indicated.
- .2 Certify ratings: units will be certified to ARI requirements.
- .3 All fin tubed coils to be finished with baked phenolic coating.
- .4 Indoor horizontal type, as indicated, having air tight modular components, consisting of the following:
 - .1 AHU-1
 - .1 Supply fan with VFD.
 - .2 Electric heating coil.
 - .3 DX Cooling Coil.

- .4 Humidifier section.
 - .5 Pre-filter section on outside air.
 - .6 High efficiency air filter section.
 - .7 Access sections.
 - .8 Outside air section with dampers.
 - .9 Return fan with VFD.
 - .10 Matched outdoor condenser unit with compressors as required for full operation of cooling when called for.
 - .11 Unit to be shipped to the job site in one piece, factory assembled, unless maximum shipping dimensions are exceeded, in which case the unit will be field assembled.
- .5 Fans and drives will be balanced to limit vibration at operating speeds.
 - .6 Maximum dimensions: as indicated.
 - .7 Controls: By Division 25 EMCS. Coordinate with Division 25 and the controls schematics in the contract drawings. Provide specialty controllers for operation of VFD's standard to the manufacturer's and coordinate their integration into the EMCS.
 - .8 Acceptable material: Engineered Air, Trane, McQuay.
 - .9 Unit casing shall be factory insulated.
 - .10 The air-handling unit shall be power wired for a single point connection. All power loads to be wired to one point of power source entrance.

2.2 CASINGS

- .1 Units shall have double wall, 50.8 mm insulated panels for walls, roof and floor.
 - .1 Plain steel parts, where not galvanized, paint with corrosion resistant paint + CAN/CGSB 1.181-99.
 - .2 Paint: Maximum VOC limit 250 g/L to standard G3-11
 - .3 Finish units, inside and out with rust resistant enamel.
 - .4 Enamel Finish: Maximum VOC limit 250 g/L to standard GS-11 to SCAQMD Rule 1113.

- .2 Exterior skin will be galvanized steel 16 gauge reinforced and braced for rigidity. Unit casing will be insulated with spray injected foam to achieve a minimum thermal resistance of 2.11 m² K/W. Insulation application shall meet the requirements of NFPA 90A and be water resistant.
- .3 Unit casing radiated sound ratings will be reported in accordance with ISO 9614, Parts 1 and 2 and ANSI S12.12.
- .4 Panel deflection will not exceed L/240 at ±203.2 mm static pressure differential across casing.
- .5 Access doors:
 - .1 Stainless steel hinges with hand operable latches using a roller cam latching mechanism. Locate for access to drain pans, motors, fans, coils, dampers, actuators, instruments, humidifier.
 - .2 Right or left hand access as indicated.
- .6 Line entire casing with solid G90 galvanized sheet steel liner, except where otherwise noted.
- .7 Configure units to maintain 609 mm clear access upstream and downstream of coil section for inspection and cleaning.
- .8 Provide marine lights with Lex and bulb covers with metal protective cage in each section provided with an access door. Lights shall be compact fluorescent type and wired in liquid tight flex conduit to be switch with pilot light. Lights shall be powered from the local control panel.

2.3 ACOUSTIC LINER

- .1 Ensure that expanded polystyrene and polyurethane insulation materials were not produced with ozone depleting substances.
- .2 Insulate internal surface of return fan, supply fan section and mixing box section panels with 50 mm neoprene coated rigid duct liner of 72 kg/m with clip pins. Cover with 0.8 mm thick perforated galvanized sheet metal. Cover leading and trailing edges with sheet metal nosing and at all edges around access doors and panels complete with 15 mm overlap.

2.4 DRAIN PANS

- .1 Comply with the guidelines of ASHRAE 62.
- .2 Construction: stainless steel. Rounded corners.
- .3 Insulation: external foam type, minimum 13 mm thick.
- .4 Drain connection: in bottom at low point and same material as drain pan.
- .5 Installation: slope in two directions with at least 10.5 mm per meter and have no horizontal surface to ensure no standing water at any time or at any point.
- .6 Dimensions: minimum 75 mm from upstream face of coil or humidifier nozzles to 300 mm beyond downstream face of coil or eliminator and to include all return bends and headers.
- .7 Provide at coil section, humidifier section, mixing box.

2.5 FANS

- .1 Centrifugal fans with backward inclined, forward curved or airfoil blades, AMCA - rated for sound and performance, selected to operate in stable part of performance curve at all times and heavy duty 200,000 hours service self aligning split pillow block bearings complying with ANSI/AFBMA9. Provide internally mounted motor as indicated complete with adjustable V-belt drive and guard compatible with variable Frequency Drives.
- .2 Supply Discharge: As indicated.
- .3 Return Intake: As indicated.
- .4 Performance: As indicated and in accordance with AMCA 210.
- .5 Fan drives shall be selected for a 1.5 service factor and shall be finished with anti-static belts. Fan motors shall be rated for inverter duty to NEMA MG1 Part 31 and to ASHRAE Standard 90.1.
- .6 Internally mounted motor and fan to be completed with vibration isolated.
 - .1 Fan motor shall be on an adjustable base.
 - .2 Fan discharge shall be connected to cabinet via a flexible connection.

.3 Access doors shall be provided for maintenance.

.7 Maximum sound power levels: Lwa not to exceed 82, 81, 83 at 250, 500, 1000 Hz frequency on inlet or outlet of fan unless indicated otherwise.

2.6 VIBRATION ISOLATION

.1 Flexible connections at inlet and outlet of fan: to Section - 23 33 00 - Air Duct Accessories.

.2 Vibration isolators and seismic restraint on fan sections, spring mount type to Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping Equipment. Select spring for minimum 50 mm static deflection.

2.7 FILTER BOX

.1 Material to match casing. For 50mm thick MERV 8 efficiency pleated filters and 300 mm thick MERV 13 rigid filters. Provide access to filter through hinged door with suitable hardware.

.2 Provide blank-off plates and gaskets to prevent air bypass.

.3 Filters: to Section 23 44 00 - HVAC Air Filtration.

.4 Immediately prior to occupancy, replace filtration media with new filtration media with maximum efficiency reporting valve (MERV) of 13 in accordance with ASHRAE 52.2.

2.8 MIXING BOX

.1 Material to match casing and produce uniformly mixed air temperature within plus or minus 5°C of design across face of outlet.

.2 Dampers:

.1 Dampers for mixing boxes: Provided by air handling unit vendor to Section 23 33 15 - Dampers - Operating. Damper actuators by Division 25.

- .3 Drain pan.
- .4 Angle air mixers required at the return and outside air inlet openings of the unit. Air mixer shall be constructed of 22 gauge galvanized sheet metal securely fastened together by tek-screws, rivets and/or spot welding. No additional space shall be required upstream of mixing plenum. Warm and cold air streams shall be passed through narrow cross sections in alternating layers. The design of the air mixer shall be such that complete air mixing shall be achieved in a short distance using:
 - .1 Heat transfer through the sheet metal walls between various layers of warm and cold air streams.
 - .2 Effective mixing mechanisms such as mixing enhancers.
 - .3 Air velocity leaving the air mixer shall be uniform and shall not cause non-uniform velocity across the downstream components, such as filters and coils.
 - .4 The air pressure drop across the angle air mixer shall not exceed 0.20" w.c.

2.9 COILS

- .1 Type: As indicated.
- .2 Ratings: ARI Certified.
- .3 Performance: As indicated.
- .4 Construction: copper tubes, aluminum fins. Cleanable.
- .5 Steel headers.
- .6 Coil segment door clearances will allow for at least 50.8 mm of field installed piping insulation.
- .7 SS IAQ drain pan for cooling coil that extends at least 152 mm downstream of the last coil in the section.
- .8 Pressure Tests: 1.7 MPa.
- .9 Finish: baked phenolic coating to be applied to coils.
- .10 3-Stage integral circuit required for cooling coil. Cooling coil circuiting must be intertwined such that 100% of the air will pass through each circuit.

- .11 Refrigerant Accessories:
 - .1 To CSA B52
 - .2 Include for each refrigerant circuit:
 - .1 Thermal expansion valve per distributor.
 - .2 Factory installed liquid line filter driers
 - .3 Liquid sight glass with moisture indicator.
 - .4 Solenoid Valves
 - .5 Liquid line service valves (with gauge port)
 - .6 Suction line service valves (with gauge port)
 - .7 Phase loss/Reverse rotation monitor
 - .8 External high pressure cutout devices
 - .9 External low pressure cutout devices
 - .10 Evaporator defrost control
 - .11 Loss of charge protection
 - .12 Suction line insulation: Flexible elastomer unicellar to ASTM C 547, 12 mm minimum thickness and as per local Code requirements

2.10 ELECTRICAL MOTORS

- .1 Fan motors shall be built in accordance with the latest NEMA and IEEE standards.
- .2 Fan motors shall comply with ASHRAE Standard 90.1.
- .3 Fan motors shall be furnished in sizes, electrical power and starting characteristics as shown in performance specifications and in drawing schedules.
 - .1 Fan motors shall be rated for continuous, full load duty at 104°F (40°C) ambient temperature and 1.15 service factor.
 - .2 Fan motors will be NEMA design ball bearing type.
 - .1 Direct drive plenum fans will be coupled with motors that closely match required fan RPM.
 - .3 Fan motors will meet, at a minimum, NEMA high efficiency standards.

- .1 Motors will be inverter duty suitable for use with variable frequency drives, per NEMA MG-1 Part 30.

2.11 FAN MOTOR DISCONNECTS

- .1 Fan motor disconnects shall be provided with unit.
- .2 Disconnect shall be housed in a NEMA 1 enclosure, and shall be mounted on the primary access side of segment.
- .3 Disconnect will be suitable for use as a lockout/tagout disconnect when applied in accordance with the Canadian Electrical Code.
- .4 Disconnect handles can be padlocked in the "off" position with up to three padlocks. Switch mechanism can be directly padlocked in the "off" position when door is open.
- .5 Disconnects will be provided with an integral ground lug.
 - .1 16A to 100A disconnects will have two (2) #14 ground wires.
 - .2 200A to 400A disconnects will have one (1) #6-250 ground wire.

2.12 FAN VARIABLE FREQUENCY DRIVES

- .1 Variable frequency drives to be factory supplied mounted at lower level of AHU's and wired to motor with units.
- .2 VFDs shall be ULC listed and comply with applicable provisions of the Canadian Electrical Code.
- .3 VFDs shall be housed in a dedicated compartment.
- .4 VFDs shall be programmed and started by a factory trained and employed technician by the AHU vendor.
- .5 VFD shall include harmonic distortion feedback protection:
- .6 Swinging DC Line Choke (equivalent to 5% input line reactor)
- .7 Integral FRI/EMI filtering to meet EMC EN61800-3 for First Environment.
- .8 User interface shall include:

- .1 30 Character multi-lingual alphanumeric display.
- .2 Parameter set-up and operating data.
- .3 Display data includes:
 - .1 output frequency (Hz)
 - .2 speed (RPM)
 - .3 motor current
 - .4 calculated % motor torque
 - .5 calculated motor power (kW)
 - .6 DC bus voltage
 - .7 output voltage
 - .8 heat sink temperature
 - .9 elapsed time meter (re-settable)
 - .10 kWh (re-settable)
 - .11 input/output terminal monitor
 - .12 PID actual value (feedback) & error
 - .13 fault text
 - .14 warning text
 - .15 scalable process variable display
- .9 VFD protection circuits will include:
 - .1 over current
 - .2 ground fault
 - .3 over voltage
 - .4 under voltage
 - .5 over temperature
 - .6 input power loss of phase
 - .7 loss of reference/feedback
 - .8 adjustable current limit regulator
- .10 VFD will be UL 508C approved for electronic motor overload (12t). VFD will include high input transient protection and surge suppression:
 - .1 4 MOVs ahead of diode bridge
 - .2 120 Joule rated 1600V diode module

- .3 Compliant with UL 1449/ANSI 61.4
- .11 VFD communication features include:
 - .1 Two programmable analog inputs
 - .2 Six programmable digital inputs
 - .3 Two programmable analog outputs
 - .4 Three programmable digital relay outputs
 - .5 Adjustable filters on analog inputs and outputs
 - .6 Input speed signals, including 4-20 mA and 0-10 VDC
 - .7 Acceleration/Decelerations contacts (floating point control)
 - .8 Auto restart (operator selectable and adjustable)
 - .9 Start/stop options will include 2 wire (dry contact closure), 3 wire (momentary contacts), application of input power, and application of reference signal (PID sleep/wake-up)
 - .10 Integrated control interface to EMCS.
- .12 VFD will have the following functions:
 - .1 Pre-magnetization on start
 - .2 DC braking/hold at stop
 - .3 Ramp or coast to stop
 - .4 Seven preset speeds
 - .5 Three critical frequency lockout bands
 - .6 Start function will include ramp, flying start, automatic torque boost, and automatic torque boost with flying start.
- .13 Provide EMCS interface for points as indicated on control schematic drawing.

2.13 OUTDOOR CONDENSING UNIT - AHU-1

- .1 Type: outdoor air source condensing unit, 3 compressors for 3 equal capacity stages, packaged to match corresponding cooling coil.
- .2 Refrigerant: R410A.
- .3 Electrical: 575 V/60 Hz/3 Ph.
- .4 Nominal capacity: matched to cooling coil.

- .5 Compressors: hermetic scroll compressor with crankcase heater, oil pump, internal and external current sensitive overload and over-temperature protection.
- .6 Fan: propeller type with vertical discharge, direct-driven from permanently lubricated motor.
- .7 Coil: aluminum plate fins mechanically bonded to copper tubing with all joints brazed.
- .8 Finish: primer and corrosion restraint coatings, baked phenolic coating to be applied to coils
- .9 Controls and protective devices to include:
 - .1 High pressure stat, loss-of-charge pressure stat.
 - .2 Crankcase heater.
 - .3 Suction line accumulator.
 - .4 Pressure relief device.
 - .5 Short-cycle protection of compressor.
 - .6 Compressor staging on/off control by EMCS.
 - .7 3-stage cooling with integral circuit.
 - .8 Common alarm contact.
- .10 Refrigerant Accessories:
 - .1 To CSA B52
 - .2 Include for each refrigerant circuit:
 - .1 Thermal expansion valve per distributor.
 - .2 Factory installed liquid line filter driers
 - .3 Liquid sight glass with moisture indicator.
 - .4 Solenoid Valves
 - .5 Liquid line service valves (with gauge port)
 - .6 Suction line service valves (with gauge port)
 - .7 Phase loss/Reverse rotation monitor
 - .8 External high pressure cutout devices
 - .9 External low pressure cutout devices
 - .10 Evaporator defrost control
 - .11 Loss of charge protection

- .12 Suction line insulation: Flexible elastomer unicellar to ASTM C 547, 12 mm minimum thickness and as per local Code requirements

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Provide appropriate protection apparatus.
- .2 Install units in accordance with manufacturer's instructions and as indicated.
- .3 Ensure adequate clearance for servicing and maintenance.
- .4 Refer to drawings for clearance requirements from building.

3.2 FANS

- .1 Install fan sheaves required for final air balance.
- .2 Install flexible connections at fan inlet and fan outlets.
- .3 Install vibration isolators.

3.3 DRIP PANS

- .1 Install deep seal P-traps and trap seal primer on drip lines.
 - .1 Depth of water seal to be 1.5 times static pressure at this point.

3.4 OUTDOOR CONDENSING UNIT

- .1 Provide interconnecting field control wiring to Air Handling Units in accordance with Division 26.

- .2 Provide interconnecting refrigerant piping to Air Handling Units in accordance with section 23 23 00 - Copper Tubing and Fittings Refrigerant.
- .3 All refrigerant accessories by the refrigerant installer.

3.5 START-UP AND PERFORMANCE VERIFICATION

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements, supplemented as specified herein.
- .2 Report forms as specified in Section 01 91 13 - General Commissioning (Cx) Requirements, report forms and schematics.
- .3 Install outdoor condensing units with neoprene mounts and galvanized or SS fasteners, anchor to concrete housekeeping pad.

3.6 CLEANING

- .1 Cleaning in accordance with Section 01 74 00 – Cleaning and Waste Processing.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA B52-13, Mechanical Refrigeration Code.
 - .2 CAN/CSA-C656-2014, Performance Standard for Split-System and Single Package Central Air-Conditioners and Heat Pumps.
- .2 Environment Canada, (EC)/Environmental Protection Services (EPS)
 - .1 EPS 1/RA/2-1996, Code of Practice for Elimination of Fluorocarbons Emissions from Refrigeration and Air Conditioning Systems.
 - .2 Environment Canada-1994, Ozone-Depleting Substances Alternatives and Suppliers List.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate major components and accessories including sound power levels of units.
- .3 Type of refrigerant used.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 10 – Closeout Submittals.

1.5 WARRANTY

- .1 For refrigeration compressors, the 12 months warranty period prescribed in subsection GC 32.1 of General Conditions "C" is extended to 5 years.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Integrated package: to CAN/CSA-C656.
- .2 System type:
 - .1 Air flow arrangement: Wall mounted horizontal discharge with modulating swing louvers.
 - .2 Cooling: direct expansion.
 - .3 Condensing: air cooled.
- .3 Unit capacity: as indicated.
- .4 Fan capacity to provide for dry coil operation at 22 degrees C and 50% R.H.

2.2 SINGLE ZONE DUCTLESS SPLIT SYSTEM

- .1 Ductless single mini split cooling unit: to CAN/CSA-C656.
- .2 System Type:
 - .1 The outdoor unit shall be pre-charged with R410A refrigerant or other HFC based equivalent.
 - .2 The system shall consist of a wall mounted evaporator section with wired control and a horizontal discharge, and a compatible single phase outdoor unit.
- .3 Outdoor Unit:
 - .1 The outdoor unit shall be compatible with the indoor unit.
 - .2 The outdoor unit shall be equipped with a control board that interfaces with the indoor unit to perform all functions necessary for operation and it shall be completely factory assembled.

- .3 This unit shall be capable of operating at -40 degrees C ambient temperature without additional low ambient controls.
- .4 The outdoor unit shall have the ability to operate with the tubing length required between the indoor and the outdoor units without additional requirement for field supplied line segments, traps or additional oil.
- .5 The unit shall be test run at the factory prior to being supplied.
- .6 The casing shall be constructed from galvanized steel plate and finished with rust protector such as acrylic paint munsell 3Y7.8/1.1 or equal.
- .7 The fan grille shall be of ABS plastic or similarly suitable material.
- .8 The unit shall be furnished with an AC fan as per the manufacturer's recommendations to match the capacity of the indoor unit.
- .9 The fan blades shall be of aerodynamic design for quiet operation.
- .10 The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front.
- .11 The L-shaped condenser coil shall be of copper tubing with flat aluminum fins to reduce debris build-up.
- .12 The coil shall be protected with an integral metal guard.
- .13 Refrigerant flow from the condenser shall be controlled by means of linear expansion valve (LEV) metering orifice. The LEV shall be controlled by a microprocessor-controlled step motor.
- .14 Finish: baked phenolic coating to be applied to louvers and coils
- .4 Compressor:
 - .1 The compressor shall be driven by inverter circuit to control compressor speed.
 - .2 The compressor speed shall match the server room load.
 - .3 The outdoor unit shall have an accumulator and high pressure safety switch.
- .5 Electrical: as indicated with single point power connection.
 - .1 The outdoor unit shall be controlled by the microprocessor located in the indoor unit.
 - .2 The control signal between the indoor and the outdoor units shall be pulse signal 24 volts DC.
 - .3 The unit shall have pulse amplitude modulation circuit which shall enable the unit to use 98% of input power supply.
- .6 Indoor Unit:
 - .1 The indoor unit shall be factory assembled, wired and tested.
 - .2 All factory wiring and internal piping, control circuit board and fan motor shall be contained within the unit.

- .3 The unit in conjunction with the remote wall mounted controller shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch.
 - .4 Refrigerant piping for the indoor unit shall be charged with helium gas before shipment from the factory.
 - .5 Return air shall be filtered by means of an easily removable and washable filter.
 - .6 The casing shall be ABS plastic and have a munsell 3.4Y7.7/0.8 finish or equal.
 - .7 Multi-directional drain and refrigerant piping offering four direction for refrigerant piping and two directions for draining shall be standard.
 - .8 The unit casing shall have a back plate which shall secure the unit firmly onto the wall.
 - .9 The evaporator fan shall produce a horizontal air jet as directed by the discharge louvres.
 - .10 The fan shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings.
 - .11 Manual adjustable louvers shall be provided to laterally change the direction of airflow.
 - .12 A motorized valve shall close the outlet port when operation is stopped, and shall also automatically direct air flow in a vertical direction for uniform air distribution.
 - .13 The fan shall consist of Low and High speeds.
 - .14 The evaporator coil shall be of nonferrous construction with aluminum strake pre-coated fins on copper tubing. All tube joints shall be brazed with phoscopper or silver alloy.
 - .15 The coils shall be pressure tested at the factory.
 - .16 A condensate pan and drain shall be provided under the coil.
 - .17 The unit shall be configured for a gravity condensate drain.
- .7 Controls:
- .1 The system shall have a wired controller to perform input functions necessary to operate the system.
 - .2 The wire controller shall have multi-language large DOT liquid crystal display and a weekly timer with multiple pattern settings per day.
 - .3 The controller shall consist of the following:
 - .1 On-Off switch
 - .2 Cool/Dry fan selector
 - .3 Thermostat setting
 - .4 Timer mode

- .5 High/Low fan speed
- .6 Auto vane selector
- .7 Check mode switch
- .8 Test Run
- .4 The controller shall have a built-in temperature sensor. It shall also consist of two microprocessors interconnected by a single non-polar two-wire cable.
- .5 Controls field wiring shall run direct from the indoor unit to the controller with no splices, and manufacturer shall provide 2 conductor non-polar 22 AWG stranded wire for connection to remote controller.
- .6 The system shall have self-diagnostics with codes for indoor and outdoor unit displayed on wired remote panel.
- .7 Controller shall display operating conditions such as pipe temperatures, compressor operating conditions, LEV opening pulses, sub-cooling and discharge super heat.
- .8 The microprocessor within the wall mounted remote controller shall provide automatic cooling, display setpoint and the computer room temperature.
- .9 Control system shall control the continued operation of the air sweep louvers as well as provide On/Off switching.
- .10 The microprocessor located in the indoor unit shall have the capability to monitor return air temperature and indoor coil temperature, receiving and processing commands from the wired controller, providing emergency operation and controlling the outdoor unit.
- .11 The control voltage from the controller to the indoor unit shall be 12 volts, DC.
- .12 The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. The system shall be capable of automatic restart when power is restored after power interruption.
- .13 CU-2 shall have interlocked operation with electric heater CUH-5.
 - .1 Heater signal to CUH-5 is sent out according to the temperature difference between set temperature and indoor room temperature (set by manufacturer).
- .8 Refrigerant Piping, Valves, Fitting and Accessories Within Unit:
 - .1 To CSA B52.
 - .2 Include for each refrigerant circuit:
 - .1 Thermal expansion valve, external equalizing type.
 - .2 Combination filter-dryer.
 - .3 Solenoid valves.

- .4 Liquid sight glass with moisture indicator.
- .5 Suction line insulation: flexible elastomeric unicellar to ASTM C 547, 12 mm minimum thickness and as per local Code requirements.
- .9 Refrigerant Charge:
 - .1 Holding charge of refrigerant applied at factory.
- .10 Acceptable material: Mitsubishi, Lennox, Friedrich, Samsung.

2.3 SPLIT SYSTEM – INDOOR DX-2 AND OUTDOOR CONDENSING UNIT - CU-4

- .1 Type: outdoor air source condensing unit, single staged, packaged to match corresponding cooling coil.
 - .1 Refrigerant: R410A.
 - .2 Electrical: 208 V/60 Hz/1 Ph.
 - .3 Nominal capacity: matched to cooling coil.
 - .4 Compressors: hermetic scroll compressor with crankcase heater, oil pump, internal and external current sensitive overload and over-temperature protection.
 - .5 Fan: propeller type with vertical discharge, direct-driven from permanently lubricated motor.
 - .6 Coil: aluminum plate fins mechanically bonded to copper tubing with all joints brazed.
 - .7 Finish: factory applied baked phenolic coating on louvers and fin tubed coils.
- .2 Evaporator: DX-2 coil linked to operation of ERV-3. DX coil and condensing unit to be of same manufacturer.
 - .1 Coil: aluminum plate fins and 13 mm OD copper tubes. Suction header are to be made of copper tubing, distributor connection are made of brass and both allow for sweat connection of refrigerant lines. Coil has vertical distributor to ensure each coil circuit receives the same amount of refrigerant liquid. coil to be pressure tested to 3103 kPa and leak tested to 2069kPa. Working pressure 2069 kPa at 121°C. AHRI certified.
 - .2 Drain Pans:
 - .1 Comply with the guidelines of ASHRAE 62.
 - .2 Construction: stainless steel. Rounded corners.
 - .3 Insulation: external foam type, minimum 13 mm thick.
 - .4 Drain connection: in bottom at low point and same material as drain pan.

- .5 Installation: slope in two directions with at least 10.5 mm per meter and have no horizontal surface to ensure no standing water at any time or at any point.
 - .6 Dimensions: minimum 75 mm from upstream face of coil or humidifier nozzles to 300 mm beyond downstream face of coil or eliminator and to include all return bends and headers.
 - .7 Provide at coil section.
- .3 Refrigerant Piping, Valves, Fitting and Accessories Within Unit:
- .1 To CSA B52.
 - .2 Include for each refrigerant circuit:
 - .3 Thermal expansion valve, external equalizing type.
 - .4 Combination filter-dryer.
 - .5 Solenoid valves.
 - .6 Liquid sight glass with moisture indicator.
 - .7 Suction line insulation: flexible elastomeric unicellar to ASTM C 547, 12 mm minimum thickness and as per local Code requirements.
- .4 Controls and protective devices to include:
- .1 High pressure stat, loss-of-charge pressure stat.
 - .2 Crankcase heater.
 - .3 Suction line accumulator.
 - .4 Pressure relief device.
 - .5 Short-cycle protection of compressor.
 - .6 Compressor electronic thermostate to Section 23 05 19.01 - Thermometers And Pressure Gauges - Piping Systems.
- .5 Acceptable Material: Trane, Engineered Air, McQuay.

PART 3 EXECUTION

3.1 GENERAL

- .1 Air Conditioning Units and Condensing Units:
 - .1 Install evaporator units and condensing units according to manufacturer's recommendations, and in accordance with EPS 1/RA/2.
 - .2 Supply and install refrigeration piping by following the manufacturer's recommendations. Refrigerant piping (Liquid line and suction line) shall be separately insulated.
 - .3 Obtain final refrigerant piping and wiring diagrams from the supplier.
 - .4 Provide all required control wiring and power wiring for a complete installation.
 - .5 The refrigerant distribution circuit and piping shall be designed and selected according to the manufacturer's specifications.
 - .6 Manufacturer to certify installation.
 - .7 Provide galvanized steel stand for outside unit and secure to concrete housekeeping pad with galvanized or SS fasteners.

3.2 EQUIPMENT PREPARATION

- .1 Provide services of manufacturer's field engineer to set and adjust equipment for operation as specified.

3.3 FIELD QUALITY CONTROL

- .1 Performance Verification:
 - .1 Refer to Commissioning Plan.

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for packaged electrode steam generating, type humidifiers and accessories.
- .2 Related Sections:
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 01 32 00 - Construction Progress Documentation.
 - .3 Section 01 35 23 - Health and Safety.
 - .4 Section 01 45 00 - Quality Control.
 - .5 Section 01 91 13 - General Commissioning (Cx) Requirements.
 - .6 Section 23 31 13.01 - Metal Ducts - Low Pressure to 500 Pa.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet for heating, ventilation and air conditioning distribution piping and ductwork.
- .3 Shop Drawings:
 - .1 Submit shop drawings to indicate project layout, dimensions and extent of humidification system.

- .4 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .6 Instructions: submit manufacturer's installation instructions.
- .7 Manufacturer's field reports specified.
- .8 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 10 – Closeout Submittals.

1.4 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing, for inclusion into operating manual.
 - .3 Spare steam cylinder.

PART 2 PRODUCTS

2.1 PACKAGED ELECTRIC RESISTANT STEAM GENERATING TYPE

- .1 CSA certified and ULC listed.
- .2 For use with tap water.
- .3 Components housed in factory fabricated cabinet, steel construction, evaporating chamber insulation and electrically interlocked door. Replacement type steam cylinder with electrodes.
- .4 HUM-1 modulating control.
- .5 Provide drain cooler.

- .6 Water level control by float valve and low water cut off switch.
- .7 Controls:
 - .1 Modulating control.
 - .2 Solenoid valve on water and drain line.
 - .3 Duct humidistat, ON-OFF High limit.
 - .4 Pressure airflow proving switch.
 - .5 Duct humidity transmitter, coordinate with Division 25 for supply.
 - .6 As coordinated with Div 25 for interface to EMCS. Minimum enable, % setpoint and alarm points.
- .8 Key pad mounted on control cabinet.
- .9 Dispersion:
 - .1 Duct distribution by single dispersion tube, 304 Stainless Steel, insulated, horizontal airflow, 13.2 kg/h, header inside duct, water seal outside duct, no condensate drain 15% slope towards humidifier.
- .10 Acceptable Materials:
 - .1 Humidifier - HUM-1: Dri Steem XTS-003, Nortec, Neptronic.
 - .2 Dispersion Panel: Single Tube, Nortec, Neptronic.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Install in accordance with manufacturers' instructions.
- .2 Humidifier media to be new and clean when project is accepted.

- .3 Install humidistat as indicated and in accessible location.
- .4 Water service overflow drain: as indicated and to manufacturers' recommendation.
- .5 Install access doors or panels in adjacent ducting.
- .6 Install capped drain connection at low point in duct.

3.3 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
 - .2 Manufacturer's Field Services: provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of the Work, after cleaning is carried out.
 - .4 Obtain reports, within 3 days of review, and submit, immediately, to Departmental Representative.
- .2 Performance Verification (PV):
 - .1 General: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.
 - .2 Timing:
 - .1 After TAB of ducted air systems.
 - .2 At same time as PV of related air handling units.

- .3 Start-up:
 - .1 General: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: General Requirements, supplemented as specified.
 - .2 Verify:
 - .1 Steam lines are sloped to ensure steam condensate is drained back to the humidifier.
 - .2 Vapour lines and manifolds are sloped to ensure condensate is drained away from the duct system.
 - .3 Visually check distribution manifold to ensure:
 - .1 Even distribution of vapour.
 - .2 Freedom from water deposits.
 - .4 Commissioning Reports:
 - .1 General: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: reports, supplemented as specified. Include:
 - .1 PV results on approved PV Report Forms.
 - .2 Product Information Report Forms.

3.4 DEMONSTRATION

- .1 Training: in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O&M Personnel.

3.5 CLEANING

- .1 Perform cleaning operations as specified in Section 01 74 00 – Cleaning and Waste Processing, and in accordance with manufacturer's recommendations.
- .2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes.
 - .1 Methods and procedures for start-up, verification and commissioning, for building Energy Monitoring and Control System (EMCS) and includes:
 - .1 Start-up testing and verification of systems.
 - .2 Check out demonstration or proper operation of components.
 - .3 On-site operational tests.
 - .2 Related Sections.
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 01 78 10 - Closeout Submittals.
 - .3 Section 01 91 13 - General Commissioning (CX) Requirements.
 - .4 Section 01 79 00 - Demonstration and Training.
 - .5 Section 25 05 01 - EMCS: General Requirements.

1.2 DEFINITIONS

- .1 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.
- .2 AEL: ratio between total test period less any system downtime accumulated within that period and test period.
- .3 Downtime: results whenever EMCS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of EMCS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:
 - .1 Outage of main power supply in excess of back-up power sources, provided that:
 - .1 Automatic initiation of back-up was accomplished.
 - .2 Automatic shut-down and re-start of components was as specified.
 - .2 Failure of communications link, provided that:

- .1 Controller automatically and correctly operated in stand-alone mode.
- .2 Failure was not due to failure of any specified EMCS equipment.
- .3 Functional failure resulting from individual sensor inputs or output devices, provided that:
 - .1 System recorded said fault.
 - .2 Equipment defaulted to fail-safe mode.
 - .3 AEL of total of all input sensors and output devices is at least 99 % during test period.

1.3 DESIGN REQUIREMENTS

- .1 Confirm with Departmental Representative that Design Criteria and Design Intents are still applicable.
- .2 Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intents.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Final Report: submit report to Departmental Representative.
 - .1 Include measurements, final settings and certified test results.
 - .2 Bear signature of commissioning technician and supervisor.
 - .3 Report format to be approved by Departmental Representative before commissioning is started.
 - .4 Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to EMCS as set during commissioning and submit to Departmental Representative in accordance with Section 01 78 10 - Closeout Submittals.
 - .5 Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide documentation, O&M Manuals, and training of O&M personnel for review of Departmental Representative before interim acceptance in accordance with Section 01 78 10 - Closeout Submittals.

1.6 COMMISSIONING

- .1 Do commissioning in accordance with Section 01 91 13 - General Commissioning (CX) Requirements.
- .2 Carry out commissioning under direction of Departmental Representative and in presence of Departmental Representative.
- .3 Inform, and obtain approval from, Departmental Representative in writing at least 14 days prior to commissioning or each test. Indicate:
 - .1 Location and part of system to be tested or commissioned.
 - .2 Testing/commissioning procedures, anticipated results.
 - .3 Names of testing/commissioning personnel.
- .4 Correct deficiencies, re-test in presence of Departmental Representative until satisfactory performance is obtained.
- .5 Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- .6 Load system with project software.
- .7 Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

- .1 Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by Departmental Representative.

1.8 ISSURANCE OR FINAL CERTIFICATE OF COMPLETION

- .1 Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

PART 2 PRODUCTS

2.1 EQUIPMENT

- .1 Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.
- .2 Instrumentation accuracy tolerances : higher order of magnitude than equipment or system being tested.
- .3 Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than 2 months prior to tests.
- .4 Locations to be approved, readily accessible and readable.
- .5 Application: to conform to normal industry standards.

PART 3 EXECUTION

3.1 PROCEDURES

- .1 Test each system independently and then in unison with other related systems.
- .2 Commission each system using procedures prescribed by the Commissioning Manager or Departmental Representative.
- .3 Commission integrated systems using procedures prescribed by Commissioning Manager or Departmental Representative.
- .4 Debug system software.
- .5 Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.

- .6 Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

3.2 FIELD QUALITY CONTROL

- .1 Pre-Installation Testing.
 - .1 General: consists of field tests of equipment just prior to installation.
 - .2 Testing may be on site or at Contractor's premises as approved by Departmental Representative.
 - .3 Configure major components to be tested in same architecture as designed system. Include BECC equipment and 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
 - .4 Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
 - .5 Additional instruments to include:
 - .1 DP transmitters.
 - .2 VAV supply duct SP transmitters.
 - .3 DP switches used for dirty filter indication and fan status.
 - .6 In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of air pressure infinitely adjustable between 0 and 500 Pa, to hold steady at any setting and with direct output to milli-amp meter at source and to BECC.
 - .7 After setting, test zero and span in 10 % increments through entire range while both increasing and decreasing pressure.
 - .8 Departmental Representative to mark instruments tracking within 0.5 % in both directions as "approved for installation".
 - .9 Transmitters above 0.5 % error will be rejected.
 - .10 DP switches to open and close within 2% of setpoint.
- .2 Completion Testing.
 - .1 General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
 - .2 Include following activities:
 - .1 Test and calibrate field hardware including stand-alone capability of each controller.
 - .2 Verify each A-to-D convertor.

- .3 Test and calibrate each AI using calibrated digital instruments.
 - .4 Test each DI to ensure proper settings and switching contacts.
 - .5 Test each DO to ensure proper operation and lag time.
 - .6 Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
 - .7 Test operating software.
 - .8 Test application software and provide samples of logs and commands.
 - .9 Verify each CDL including energy optimization programs.
 - .10 Debug software.
 - .11 Blow out flow measuring and static pressure stations with high pressure air at 700 kPa.
 - .12 Provide point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Include space on list for commissioning technician and Departmental Representative approval. This document will be used in final startup testing.
- .3 Final Startup Testing: Upon satisfactory completion of tests, perform point-by-point test of entire system under direction of Departmental Representative or Commissioning Manager and provide:
- .1 Two (2) technical personnel capable of re-calibrating field hardware and modifying software.
 - .2 Detailed daily schedule showing items to be tested and personnel available.
 - .3 Departmental Representative's acceptance signature to be on executive and applications programs.
 - .4 Commissioning to commence during final startup testing.
 - .5 O&M personnel to assist in commissioning procedures as part of training.
 - .6 Commissioning to be supervised by qualified supervisory personnel and Departmental Representative.
 - .7 Commission systems considered as life safety systems before affected parts of the facility are occupied.
 - .8 Operate systems as long as necessary to commission entire project.
 - .9 Monitor progress and keep detailed records of activities and results.
- .4 Final Operational Testing: to demonstrate that EMCS functions in accordance with contract requirements.

- .1 Prior to beginning of 30 day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
 - .1 Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
- .2 Test to last at least 30 consecutive 24 hour days.
- .3 Tests to include:
 - .1 Demonstration of correct operation of monitored and controlled points.
 - .2 Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
- .4 System will be accepted when:
 - .1 EMCS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
 - .2 Requirements of Contract have been met.
- .5 In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
- .6 Correct defects when they occur and before resuming tests.
- .5 Commissioning Manager or Departmental Representative to verify reported results.

3.3 ADJUSTING

- .1 Final adjusting: upon completion of commissioning as reviewed by Departmental Representative, set and lock devices in final position and permanently mark settings.

3.4 DEMONSTRATION

- .1 Demonstrate to Commissioning Manager or Departmental Representative operation of systems including sequence of operations in regular and emergency modes, under normal and emergency conditions, start-up, shut-down interlocks and lock-outs.

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for training program, instructors and training materials, for building Energy Monitoring and Control System (EMCS) Work.
- .2 Related Sections.
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 25 05 01 - EMCS: General Requirements.

1.2 DEFINITIONS

- .1 CDL - Control Description Logic.
- .2 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures, supplemented and modified by requirements of this Section.
- .2 Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Departmental Representative 30 days prior to anticipated date of beginning of training.
 - .1 List name of trainer, and type of visual and audio aids to be used.
 - .2 Show co-ordinated interface with other EMCS mechanical and electrical training programs.
- .3 Submit reports within one week after completion of Phase 1 and Phase 2 training program that training has been satisfactorily completed.

1.4 QUALITY ASSURANCE

- .1 Departmental Representative reserves right to approve instructors.

1.5 INSTRUCTIONS

- .1 Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of EMCS installed.
- .2 Training to be project-specific.

1.6 TIME FOR INSTRUCTION

- .1 Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

1.7 TRAINING MATERIALS

- .1 Provide equipment, visual and audio aids, and materials for classroom training.
- .2 Supply manual for each trainee, describing in detail data included in each training program.
 - .1 Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

1.8 TRAINING PROGRAM

- .1 To be in 2 phases over 1 month period.
- .2 Phase 1: 2 day program to begin before 30 day test period at time mutually agreeable to Contractor, Departmental Representative and Commissioning Manager.
 - .1 Train O&M personnel in functional operations and procedures to be employed for system operation.
 - .2 Supplement with on-the-job training during 30 day test period.

- .3 Include overview of system architecture, communications, operation of computer and peripherals, report generation.
- .4 Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.
- .3 Phase 2: 2 day program to begin 8 weeks after acceptance for operators, equipment maintenance personnel and programmers.
 - .1 Provide multiple instructors on pre-arranged schedule. Include at least following:
 - .1 Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.
 - .2 Equipment maintenance training: provide personnel with 2 days training within 5 day period in maintenance of EMCS equipment, including general equipment layout, trouble shooting and preventive maintenance of EMCS components, maintenance and calibration of sensors and controls.
 - .3 Programmers: provide personnel with 2 days training within 5 day period in following subjects in approximate percentages of total course shown:
 - .1 Application programs: 15%.
 - .2 Software and architecture: 10%.
 - .3 Controller programming: 50%.
 - .4 Trouble shooting and debugging:10%.
 - .5 Colour graphic generation: 15%.

1.9 ADDITIONAL TRAINING

- .1 List courses offered by name, duration and approximate cost per person per week. Note courses recommended for training supervisory personnel.

1.10 MONITORING OF TRAINING

- .1 Departmental Representative to monitor training program and may modify schedule and content.

PART 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

.1 Not Used.

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 General requirements for building Energy Monitoring and Control System (EMCS) that are common to NMS EMCS Sections.
- .2 Related Sections:
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 01 35 23 - Health and Safety.
 - .3 Section 01 74 20 - Waste Managing And Disposal.
 - .4 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
 - .5 Section 25 05 54 - EMCS: Identification.
 - .6 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)/The Instrumentation, Systems and Automation Society (ISA).
 - .1 ANSI/ISA 5.5-1985, Graphic Symbols for Process Displays.
- .2 American National Standards Institute (ANSI)/ Institute of Electrical and Electronics Engineers (IEEE).
 - .1 IEEE 260.1-2004993, American National Standard Letter Symbols Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).
- .3 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
 - .1 ASHRAE STD 135-R2012, BACNET - Data Communication Protocol for Building Automation and Control Network.
- .4 Canadian Standards Association (CSA International).
- .5 Consumer Electronics Association (CEA).
 - .1 CEA-709.1-D-2014, Control Network Protocol Specification.

- .6 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .7 Transport Canada (TC).
 - .1 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

1.3 ACRONYMS AND ABBREVIATIONS

- .1 Acronyms used in EMCS:
 - .1 AEL - Average Effectiveness Level.
 - .2 AI - Analog Input.
 - .3 AIT - Agreement on International Trade.
 - .4 AO - Analog Output.
 - .5 BACnet - Building Automation and Control Network.
 - .6 BC(s) - Building Controller(s).
 - .7 BECC - Building Environmental Control Center.
 - .8 CAD - Computer Aided Design.
 - .9 CDL - Control Description Logic.
 - .10 CDS - Control Design Schematic.
 - .11 COSV - Change of State or Value.
 - .12 CPU - Central Processing Unit.
 - .13 DI - Digital Input.
 - .14 DO - Digital Output.
 - .15 DP - Differential Pressure.
 - .16 ECU - Equipment Control Unit.
 - .17 EMCS - Energy Monitoring and Control System.
 - .18 HVAC - Heating, Ventilation, Air Conditioning.
 - .19 IDE - Interface Device Equipment.
 - .20 I/O - Input/Output.
 - .21 ISA - Industry Standard Architecture.
 - .22 LAN - Local Area Network.
 - .23 LCU - Local Control Unit.
 - .24 MCU - Master Control Unit.
 - .25 NAFTA - North American Free Trade Agreement.

- .26 NC - Normally Closed.
- .27 NO - Normally Open.
- .28 OS - Operating System.
- .29 O&M - Operation and Maintenance.
- .30 OWS - Operator Work Station.
- .31 PC - Personal Computer.
- .32 PCI - Peripheral Control Interface.
- .33 PCMCIA - Personal Computer Micro-Card Interface Adapter.
- .34 PID - Proportional, Integral and Derivative.
- .35 RAM - Random Access Memory.
- .36 SP - Static Pressure.
- .37 ROM - Read Only Memory.
- .38 TCU - Terminal Control Unit.
- .39 USB - Universal Serial Bus.
- .40 UPS - Uninterruptible Power Supply.
- .41 VAV - Variable Air Volume.

1.4 DEFINITIONS

- .1 Point: may be logical or physical.
 - .1 Logical points: values calculated by system such as setpoints, totals, counts, derived corrections and may include, but not limited to result of and statements in CDL's.
 - .2 Physical points: inputs or outputs which have hardware wired to controllers which are measuring physical properties, or providing status conditions of contacts or relays which provide interaction with related equipment (stop, start) and valve or damper actuators.
- .2 Point Name: composed of two parts, point identifier and point expansion.
 - .1 Point identifier: comprised of three descriptors, "area" descriptor, "system" descriptor and "point" descriptor, for which database to provide 25 character field for each point identifier. "System" is system that point is located on.
 - .1 Area descriptor: building or part of building where point is located.
 - .2 System descriptor: system that point is located on.
 - .3 Point descriptor: physical or logical point description. For point identifier "area", "system" and "point" will be shortforms or

acronyms. Database must provide 25 character field for each point identifier.

- .2 Point expansion : comprised of three fields, one for each descriptor. Expanded form of shortform or acronym used in "area", "system" and "point" descriptors is placed into appropriate point expansion field. Database must provide 32 character field for each point expansion.
- .3 Point Object Type: points fall into following object types:
 - .1 AI (analog input).
 - .2 AO (analog output).
 - .3 DI (digital input).
 - .4 DO (digital output).
 - .5 Pulse inputs.
- .4 Symbols and engineering unit abbreviations utilized in displays: to ANSI/ISA S5.5.
 - .1 Printouts: to IEEE 260.1-2004.
 - .2 Refer also to Section 25 05 54 - EMCS: Identification.

1.5 SYSTEM DESCRIPTION

- .1 Refer to control schematics for system architecture.
- .2 Work covered by sections referred to above consists of fully operational EMCS, including, but not limited to, following:
 - .1 Building Controllers.
 - .2 Control devices.
 - .3 Interconnection to existing EMCS front end in Building S-111.
 - .4 Data communications equipment necessary to effect EMCS data transmission system.
 - .5 Field control devices.
 - .6 Software/Hardware complete with full documentation.
 - .7 Complete operating and maintenance manuals.
 - .8 Training of personnel.
 - .9 Acceptance tests, technical support during commissioning, full documentation.
 - .10 Wiring interface co-ordination of equipment supplied by others.
 - .11 Miscellaneous work as specified in these sections and as indicated.

- .12 Updating of front-end graphics in Building S-111 to address all systems provided this contract. Level of graphic presentation and method of information display and operator interface with graphics to be consistent with existing.
- .3 Design Requirements:
 - .1 Design and provide conduit and wiring linking elements of system.
 - .2 Supply sufficient programmable controllers of types to meet project requirements. Quantity and points contents as reviewed by Departmental Representative prior to installation. Provide capability in network and master controller to accommodate tie-in of future building controllers.
 - .3 Location of controllers as reviewed by Departmental Representative prior to installation.
 - .4 Provide utility power to EMCS.
 - .5 Metric references: in accordance with CAN/CSA-Z234.1-00(R2011).
- .4 Language Operating Requirements: English.

1.6 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
- .2 Submit for review:
 - .1 Equipment list and systems manufacturers within 10 days after award of contract.
 - .2 List existing field control devices to be re-used included in bid tender, along with unit price.
- .3 Quality Control:
 - .1 Provide equipment and material from manufacturer's regular production, CSA certified, manufactured to standard quoted plus additional specified requirements.
 - .2 Where CSA certified equipment is not available submit such equipment to inspection authorities for special inspection and approval before delivery to site.
 - .3 Submit proof of compliance to specified standards with shop drawings and product data in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process. Label or listing of specified organization is acceptable evidence.
 - .4 In lieu of such evidence, submit certificate from testing organization, approved by Departmental Representative, certifying that item was tested

in accordance with their test methods and that item conforms to their standard/code.

- .5 For materials whose compliance with organizational standards/codes/specifications is not regulated by organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.
- .6 Permits and fees: in accordance with general conditions of contract.
- .7 Submit certificate of acceptance from authority having jurisdiction to Departmental Representative.

1.7 QUALITY ASSURANCE

- .1 Have office staffed by trained personnel capable of providing instruction, routine maintenance and emergency service on systems.
- .2 Provide record of successful previous installations submitting tender showing experience with similar installations utilizing computer-based systems.
- .3 Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after obsolescence.
- .4 Ensure qualified supervisory personnel continuously direct and monitor Work and attend site meetings.
- .5 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 2 weeks after award of Contract.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling.

PART 2 PRODUCTS

2.1 EQUIPMENT

- .1 All products used in this project installation shall be new, currently under manufacture, and shall be applied in similar installations for a minimum of two years. This installation shall not be used as a test site for any new products unless explicitly approved by the Departmental Representative in writing. Spare parts shall be available for at least five years after completion of this contract.
- .2 Complete list of equipment and materials to be used on project and forming part of tender documents by adding manufacturer's name, model number and details of materials to be submitted for approval.
- .3 All control components to be Native BacNET and BTL.
- .4 Acceptable material: Honeywell, Digicon, Johnson Controls, AEM, Controls and Equipment, Siemens.

2.2 ADAPTORS

- .1 Provide adaptors between metric and imperial components.

PART 3 EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

- .1 Installation: to manufacturer's recommendations.

3.2 PAINTING

- .1 Painting: in accordance with Section 09 91 00- Painting, supplemented as follows:
 - .1 Clean and touch up marred or scratched surfaces of factory finished equipment to match original finish.

- .2 Restore to new condition, finished surfaces too extensively damaged to be primed and touched up to make good.
- .3 Clean and prime exposed hangers, racks, fastenings, and other support components.
- .4 Paint unfinished equipment installed indoors to EEMAC 2Y-1.

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes.
 - .1 Methods and procedures for shop drawings submittals, preliminary and detailed review process including review meetings, for building Energy Monitoring and Control System (EMCS).
- .2 Related Sections.
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 25 05 01 - EMCS: General Requirements.
 - .3 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.2 DEFINITIONS

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.3 DESIGN REQUIREMENTS

- .1 Preliminary Design Review: to contain following contractor and systems information.
 - .1 Location of local office.
 - .2 Description and location of installing and servicing technical staff.
 - .3 Location and qualifications of programming design and programming support staff.
 - .4 List of spare parts.
 - .5 Location of spare parts stock.
 - .6 Names of sub-contractors and site-specific key personnel.
 - .7 Sketch of site-specific system architecture.
 - .8 Specification sheets for each item including memory provided, programming language, speed, type of data transmission.
 - .9 Descriptive brochures.
 - .10 Sample CDL and graphics (systems schematics).

- .11 Response time for each type of command and report.
- .12 Item-by-item statement of compliance.
- .13 Proof of demonstrated ability of system to communicate utilizing BACnet.

1.4 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures and coordinate with requirements in this Section.
- .2 Submit preliminary design document within 5 working days after tender closing and before contract award, for review by Departmental Representative.
- .3 Shop Drawings to consist of electronic PDF copy of design documents, shop drawings, product data and software.
- .4 Electronic copy to be completely indexed and coordinated package to assure compliance with contract requirements and arranged in same sequence as specification and cross-referenced to specification section and paragraph number.
- .5 Electronic copy for shop drawing review to submitted in PDF format with text recognition enabled. Final submittal for Project Record Documents purposes to be in PDF plus native file format acceptable to Departmental Representative and may include Autocad - latest version, WordPerfect latest version or Microsoft Word latest version, structured using menu format for easy loading and retrieval on OWS.

1.5 PRELIMINARY SHOP DRAWING REVIEW

- .1 Submit preliminary shop drawings within 30 working days of award of contract and include following:
 - .1 Specification sheets for each item. To include manufacturer's descriptive literature, manufacturer's installation recommendations, specifications, drawings, diagrams, performance and characteristic curves, catalogue cuts, manufacturer's name, trade name, catalogue or model number, nameplate data, size, layout, dimensions, capacity, other data to establish compliance.
 - .2 Detailed system architecture showing all points associated with each controller including, signal levels, pressures where new EMCS ties into existing control equipment.
 - .3 Spare point capacity of each controller by number and type.
 - .4 Controller locations.

- .5 Auxiliary control cabinet locations.
- .6 Single line diagrams showing cable routings, conduit sizes, spare conduit capacity between control centre, field controllers and systems being controlled.
- .7 Valves: complete schedule listing including following information: designation, service, manufacturer, model, point ID, design flow rate, design pressure drop, required Cv, Valve size, actual Cv, spring range, pilot range, required torque, actual torque and close off pressure (required and actual).
- .8 Dampers: sketches showing module assembly, interconnecting hardware, operator locations, operator spring range, pilot range, required torque, actual torque.
- .9 Flow measuring stations: complete schedule listing designation, service, point ID, manufacturer, model, size, velocity at design flow rate, manufacturer, model and range of velocity transmitter.
- .10 Compressor schematic and sizing data.

1.6 DETAIL SHOP DRAWING REVIEW

- .1 Submit detailed shop drawings within 30 working days after award of contract and before start of installation and include following:
 - .1 Corrected and updated versions of submissions made during preliminary review.
 - .2 Wiring diagrams.
 - .3 Piping diagrams and hook-ups.
 - .4 Interface wiring diagrams showing termination connections and signal levels for equipment to be supplied by others.
 - .5 Shop drawings for each input/output point, sensors, transmitters, showing information associated with each particular point including:
 - .1 Sensing element type and location.
 - .2 Transmitter type and range.
 - .3 Associated field wiring schematics, schedules and terminations.
 - .4 Complete Point Name Lists.
 - .5 Setpoints, curves or graphs and alarm limits (high and low, 3 types critical, cautionary and maintenance), signal range.
 - .6 Software and programming details associated with each point.
 - .7 Manufacturer's recommended installation instructions and procedures.

- .8 Input and output signal levels or pressures where new system ties into existing control equipment.
- .6 Control schematics, narrative description, CDL's fully showing and describing automatic and manual procedure required to achieve proper operation of project, including under complete failure of EMCS.
- .7 Graphic system schematic displays of air and water systems with point identifiers and textual description of system, and typical floor plans as specified.
- .8 Complete system CDL's including companion English language explanations on same sheet but with different font and italics. CDL's to contain specified energy optimization programs.
- .9 Listing and example of specified reports.
- .10 Listing of time of day schedules.
- .11 Mark up to-scale construction drawing to detail control room showing location of equipment and operator work space.
- .12 Type and size of memory with statement of spare memory capacity.
- .13 Full description of software programs provided.
- .14 Sample of "Operating Instructions Manual" to be used for training purposes.
- .15 Outline of proposed start-up and verification procedures. Refer to Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.7 QUALITY ASSURANCE

- .1 Preliminary Design Review Meeting: Convene meeting within 45 working days of award of contract to:
 - .1 Undertake functional review of preliminary design documents, resolve inconsistencies.
 - .2 Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).
 - .3 Review interface requirements of materials supplied by others.
 - .4 Review "Sequence of Operations".
- .2 Contractor's programmer to attend meeting.
- .3 Departmental Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to Departmental Representative.

PART 2 PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

.1 Not used.

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for final control diagrams and operation and maintenance (O&M) manual, for building Energy Monitoring and Control System (EMCS) Work.
- .2 Related Sections.
 - .1 Section 01 78 10 - Closeout Submittals.
 - .2 Section 25 05 01 - EMCS: General Requirements.
 - .3 Section 25 05 02 - EMCS: Submittals and Review Process.
 - .4 Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

1.2 DEFINITIONS

- .1 BECC - Building Environmental Control Centre.
- .2 OWS - Operator Work Station.
- .3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 78 10 - Closeout Procedures, supplemented and modified by requirements of this Section.
- .2 Submit Record Documents As-built drawings Operation and Maintenance Manual to Departmental Representative in English.
- .3 Provide soft copies and hard copies in hard-back, 50 mm 3 ring, D-ring binders.
 - .1 Binders to be 2/3 maximum full.
 - .2 Provide index to full volume in each binder.
 - .3 Identify contents of each manual on cover and spine.
 - .4 Provide Table of Contents in each manual.

- .5 Assemble each manual to conform to Table of Contents with tab sheets placed before instructions covering subject.

1.4 AS-BUILTS

- .1 Provide 1 copy of detailed shop drawings generated in Section 25 05 02 - EMCS: Submittals and Review Process and include:
 - .1 Changes to contract documents as well as addenda and contract extras.
 - .2 Changes to interface wiring.
 - .3 Routing of conduit, wiring and control air lines associated with EMCS installation.
 - .4 Locations of obscure devices to be indicated on drawings.
 - .5 Listing of alarm messages.
 - .6 Panel/circuit breaker number for sources of normal/emergency power.
 - .7 Names, addresses, telephone numbers of each sub-contractor having installed equipment, local representative for each item of equipment, each system.
 - .8 Test procedures and reports: provide records of start-up procedures, test procedures, checkout tests and final commissioning reports as specified in Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.
 - .9 Basic system design and full documentation on system configuration.
- .2 Submit for final review by Departmental Representative.
- .3 Provide before acceptance 4 Hard and 1 soft copy incorporating changes made during final review.

1.5 O&M MANUALS

- .1 Custom design O&M Manuals (both hard and soft copy) to contain material pertinent to this project only, and to provide full and complete coverage of subjects referred to in this Section.
- .2 Provide 2 complete sets of hard and soft copies prior to system or equipment tests.
- .3 Include complete coverage in concise language, readily understood by operating personnel using common terminology of functional and operational requirements of system. Do not presume knowledge of computers, electronics or in-depth control theory.

- .4 Functional description to include:
 - .1 Functional description of theory of operation.
 - .2 Design philosophy.
 - .3 Specific functions of design philosophy and system.
 - .4 Full details of data communications, including data types and formats, data processing and disposition data link components, interfaces and operator tests or self-test of data link integrity.
 - .5 Explicit description of hardware and software functions, interfaces and requirements for components in functions and operating modes.
 - .6 Description of person-machine interactions required to supplement system description, known or established constraints on system operation, operating procedures currently implemented or planned for implementation in automatic mode.
- .5 System operation to include:
 - .1 Complete step-by-step procedures for operation of system including required actions at each OWS.
 - .2 Operation of computer peripherals, input and output formats.
 - .3 Emergency, alarm and failure recovery.
 - .4 Step-by-step instructions for start-up, back-up equipment operation, execution of systems functions and operating modes, including key strokes for each command so that operator need only refer to these pages for keystroke entries required to call up display or to input command.
- .6 Software to include:
 - .1 Documentation of theory, design, interface requirements, functions, including test and verification procedures.
 - .2 Detailed descriptions of program requirements and capabilities.
 - .3 Data necessary to permit modification, relocation, reprogramming and to permit new and existing software modules to respond to changing system functional requirements without disrupting normal operation.
 - .4 Software modules, fully annotated source code listings, error free object code files ready for loading via peripheral device
 - .5 Complete program cross reference plus linking requirements, data exchange requirements, necessary subroutine lists, data file requirements, other information necessary for proper loading, integration, interfacing, program execution.
 - .6 Software for each Controller and single section referencing Controller common parameters and functions.

- .7 Maintenance: document maintenance procedures including inspection, periodic preventive maintenance, fault diagnosis, repair or replacement of defective components, including calibration, maintenance, repair of sensors, transmitters, transducers, controller and interface firmware's, plus diagnostics and repair/replacement of system hardware.
- .8 System configuration document:
 - .1 Provisions and procedures for planning, implementing and recording hardware and software modifications required during operating lifetime of system.
 - .2 Information to ensure co-ordination of hardware and software changes, data link or message format/content changes, sensor or control changes in event that system modifications are required.
- .9 Programmer control panel documentation: provide where panels are independently interfaced with BECC, including interfacing schematics, signal identification, timing diagrams, fully commented source listing of applicable driver/handler.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 EXECUTION

3.1 NOT USED

- .1 Not Used.

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for identification of devices, sensors, wiring, conduit and equipment, for building Energy Monitoring and Control System (EMCS) Work and nameplates materials, colours and lettering sizes.
- .2 Related Sections.
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 25 05 01 - EMCS: General Requirements.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.1-12, The Canadian Electrical Code, Part I (19th Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

- .1 For acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.4 SYSTEM DESCRIPTION

- .1 Language Operating Requirements: provide identification for control items in English.

1.5 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures supplemented and modified by requirements of this Section.

- .2 Submit to Departmental Representative for approval samples of nameplates, identification tags and list of proposed wording.

PART 2 PRODUCTS

2.1 NAMEPLATES FOR PANELS

- .1 Identify by Plastic laminate, 3 mm thick Melamine, matt white finish, black core, square corners, lettering accurately aligned and engraved into core.
- .2 Sizes: 25 x 67 mm minimum.
- .3 Lettering: minimum 7 mm high, black.
- .4 Inscriptions: machine engraved to identify function.

2.2 NAMEPLATES FOR FIELD DEVICES

- .1 Identify by plastic encased cards attached by chain plastic tie.
- .2 Sizes: 50 x 100 mm minimum.
- .3 Lettering: minimum 5 mm high produced from laser printer in black.
- .4 Data to include: point name and point address.
- .5 Companion cabinet: identify interior components using plastic enclosed cards with point name and point address.

2.3 NAMEPLATES FOR ROOM SENSORS

- .1 Identify by stick-on labels using point identifier.
- .2 Location: as directed by Departmental Representative.
- .3 Letter size: to suit, clearly legible.

2.4 WARNING SIGNS

- .1 Equipment including motors and starters under remote automatic control: supply and install orange coloured signs warning of automatic starting under control of EMCS.
- .2 Sign to read: "Caution: This equipment is under automatic remote control of EMCS" as reviewed by Departmental Representative.

2.5 WIRING

- .1 Supply and install numbered tape markings on wiring at panels, junction boxes, splitters, cabinets and outlet boxes.
- .2 Colour coding: to CSA C22.1-09. Use colour coded wiring in communications cables, matched throughout system.
- .3 Power wiring: identify circuit breaker panel/circuit breaker number inside each EMCS panel.

2.6 PNEUMATIC TUBING

- .1 Numbered tape markings on tubing to provide uninterrupted tracing capability.

2.7 CONDUIT

- .1 Colour code EMCS conduit.
- .2 Pre-paint box covers and conduit fittings.
- .3 Coding: use fluorescent orange paint and confirm colour with Departmental Representative during "Preliminary Design Review".

PART 3 EXECUTION

3.1 NAMEPLATES AND LABELS

- .1 Ensure that manufacturer's nameplates, CSA labels and identification nameplates are visible and legible at all times.

3.2 EXISTING PANELS

- .1 Correct existing nameplates and legends to reflect changes made during Work.

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes.
 - .1 Requirements and procedures for warranty and activities during warranty period and service contracts, for building Energy Monitoring and Control System (EMCS).
- .2 Related Sections.
 - .1 Section 01 33 00 - Submittal Procedures.
 - .2 Section 01 78 10 - Closeout Submittals.
 - .3 Section 25 05 01 - EMCS: General Requirements.
- .3 References.
 - .1 Canada Labour Code (R.S. 1985, c. L-2)/Part I - Industrial Relations.
 - .2 Canadian Standards Association (CSA International).
 - .1 CSA Z204-94(R1999), Guidelines for Managing Indoor Air Quality in Office Buildings.

1.2 DEFINITIONS

- .1 BC(s) - Building Controller(s).
- .2 OWS - Operator Work Station.
- .3 For additional acronyms and definitions refer to Section 25 05 01 - EMCS: General Requirements.

1.3 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit detailed preventative maintenance schedule for system components to Departmental Representative.
- .3 Submit detailed inspection reports to Departmental Representative.

- .4 Submit dated, maintenance task lists to Departmental Representative and include the following sensor and output point detail, as proof of system verification:
 - .1 Point name and location.
 - .2 Device type and range.
 - .3 Measured value.
 - .4 System displayed value.
 - .5 Calibration detail
 - .6 Indication if adjustment required,
 - .7 Other action taken or recommended.
- .5 Submit network analysis report showing results with detailed recommendations to correct problems found.
- .6 Records and logs: in accordance with Section 01 78 10 - Closeout Submittals.
- .7 Maintain records and logs of each maintenance task on site.
 - .1 Organize cumulative records for each major component and for entire EMCS chronologically.
 - .2 Submit records to Departmental Representative, after inspection indicating that planned and systematic maintenance have been accomplished.
- .8 Revise and submit to Departmental Representative in accordance with Section 01 78 20 - Closeout Submittals "As-built drawings" documentation and commissioning reports to reflect changes, adjustments and modifications to EMCS made during warranty period.

1.4 MAINTENANCE SERVICE DURING WARRANTY PERIOD

- .1 Provide services, materials, and equipment to maintain EMCS for specified warranty period. Provide detailed preventative maintenance schedule for system components as described in Submittal article.
- .2 Emergency Service Calls:
 - .1 Initiate service calls when EMCS is not functioning correctly.
 - .2 Qualified control personnel to be available during warranty period to provide service to "CRITICAL" components whenever required at no extra cost.
 - .3 Furnish Departmental Representative with telephone number where service personnel may be reached at any time.

- .4 Service personnel to be on site ready to service EMCS within 4 hours after receiving request for service.
- .5 Perform Work continuously until EMCS restored to reliable operating condition.
- .3 Operation: foregoing and other servicing to provide proper sequencing of equipment and satisfactory operation of EMCS based on original design conditions and as recommended by manufacturer.
- .4 Work requests: record each service call request, when received separately on approved form and include:
 - .1 Serial number identifying component involved.
 - .2 Location, date and time call received.
 - .3 Nature of trouble.
 - .4 Names of personnel assigned.
 - .5 Instructions of work to be done.
 - .6 Amount and nature of materials used.
 - .7 Time and date work started.
 - .8 Time and date of completion.
- .5 Provide system modifications in writing.
 - .1 No system modification, including operating parameters and control settings, to be made without prior written approval of Departmental Representative.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

- .1 Perform as minimum (3) three minor inspections and one major inspection (more often if required by manufacturer) per year. Provide detailed written report to Departmental Representative as described in Submittal article.
- .2 Perform inspections during regular working hours, 0800 to 1630 hrs, Monday through Friday, excluding statutory holidays.
- .3 Following inspections are minimum requirements and should not be interpreted to mean satisfactory performance:
 - .1 Perform calibrations using test equipment having traceable, certifiable accuracy at minimum 50% greater than accuracy of system displaying or logging value.
 - .2 Check and Calibrate each field input/output device in accordance with Canada Labour Code - Part I and CSA Z204-94(R1999).
 - .3 Provide dated, maintenance task lists, as described in Submittal article, as proof of execution of complete system verification.
- .4 Minor inspections to include, but not limited to:
 - .1 Perform visual, operational checks to BC's, peripheral equipment, interface equipment and other panels.
 - .2 Check equipment cooling fans as required.
 - .3 Visually check for mechanical faults, air leaks and proper pressure settings on pneumatic components.
 - .4 Review system performance with Departmental Representative to discuss suggested or required changes.
- .5 Major inspections to include, but not limited to:
 - .1 Minor inspection.
 - .2 Clean OWS(s) peripheral equipment, BC(s), interface and other panels, micro-processor interior and exterior surfaces.
 - .3 Check signal, voltage and system isolation of BC(s), peripherals, interface and other panels.
 - .4 Verify calibration/accuracy of each input and output device and recalibrate or replace as required.
 - .5 Provide mechanical adjustments, and necessary maintenance on printers.
 - .6 Run system software diagnostics as required.

- .7 Install software and firmware enhancements to ensure components are operating at most current revision for maximum capability and reliability.
 - .1 Perform network analysis and provide report as described in Submittal article.
- .6 Rectify deficiencies revealed by maintenance inspections and environmental checks.
- .7 Continue system debugging and optimization.
- .8 Testing/verification of occupancy and seasonal-sensitive systems to take place during four (4) consecutive seasons, after facility has been accepted, taken over and fully occupied.
 - .1 Test weather-sensitive systems twice: first at near winter design conditions and secondly under near summer design conditions.

PART 1 GENERAL

1.1 DEFINITIONS

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.2 OWS SYSTEM DESCRIPTION

- .1 Consists of a colour touch screen tablet computer intended for wall mounting.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Make submittals in accordance with Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.

1.4 ENVIRONMENTAL CONDITIONS

- .1 OWS to operate in conditions of 10degrees C to 32degrees C and 20 % to 90 % non-condensing RH.

1.5 MAINTENANCE

- .1 Provide maintenance in accordance with Section 25 05 03 - EMCS: Project Record Documents.

PART 2 PRODUCTS

2.1 OWS HARDWARE

- .1 System to include:
 - .1 Processor: capable of supporting software necessary to perform functions specified in this section
 - .2 Internal clock.
 - .1 Uninterruptible clock: accuracy of plus or minus 5 seconds/month, capable of deriving year / month / day / hour / minute / second.
 - .2 Rechargeable batteries: to provide minimum 48 h clock operation in event of power failure.
 - .3 Asynchronous interfaces for connection to listed peripheral devices including LAN and remote devices.
 - .2 Power supply unit to accept 120 V 60 Hz source and include line surge and low voltage protection for processor and its peripherals.
 - .3 Include UPS to provide 5minutes minimum operation of PC, CRT and communication and peripheral devices; applies to fixed (non portable) OWSs and peripherals.
 - .4 Internal memory as required storage of trend data and operator reports.
 - .5 USB port.
 - .6 380mm colour touch screen display.

2.2 OWS CONTROL SOFTWARE

- .1 OWS is not to form part of real-time control functions either directly or indirectly or as part of communication link. Real-time control functions to reside in MCUs, LCUs, and TCUs with peer to peer communication occurring at MCU to MCU device level.
- .2 Time Synchronization Module.
 - .1 System to provide Time Synchronization of real-time clocks in controllers.
 - .2 System to perform this feature on regular scheduled basis and on operator request.

- .3 User Display Interface Module.
 - .1 OWS software to support "Point Names" as defined in Section 25 05 01 - EMCS: General Requirements.
 - .2 Upon operator's request in either text, graphic or table mode, system to present condition of single point, system, area, or connected points on system to OWS. Display analog values digitally to 1 place of decimal with negative sign as required. Update displayed analog values and status when new values received. Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm. For systems supporting COSV, refresh rate of screen data not to exceed 5 seconds from time of field change and system is to execute supervisory background scan every 20 seconds to verify point data value. For other systems refresh rate not to exceed 5 seconds for points displayed. Initial display of new system graphic display (with up to 30 active points), including presentation of associated dynamic data not to exceed 8 seconds.
- .4 General Event Log Module: to record system activities occurring at OWS or elsewhere in system including:
 - .1 Operator Log-in from user interface device.
 - .2 Communication messages: errors, failures and recovery.
 - .3 Event notifications and alarms by category.
 - .4 Record of operator initiated commands.
- .5 General Event Log:
 - .1 Hold minimum of 4 months information and be readily accessible to operator.
 - .2 Able to be archived as necessary to prevent loss of information.
- .6 Operator Control Software Module: to support entry of information into system from another network device. Display of information to user; dynamic displays, textual displays, and graphic displays to display logging and trending of system information and following tasks:
 - .1 Automatic logging of digital alarms and change of status messages.
 - .2 Automatic logging of analog alarms.
 - .3 System changes: alarm limits, set-points, alarm lockouts.
 - .4 Display specific point values, states as selected.
 - .5 Provide reports as requested and on scheduled basis when required.
 - .6 Display graphics as requested, and on alarm receptions (user's option).
 - .7 Display list of points within system.
 - .8 Display list of systems within building.

- .9 Direct output of information to selected peripheral device.
- .10 On-line changes:
 - .1 Alarm limits.
 - .2 Setpoints.
 - .3 Deadbands.
 - .4 Control and change of state changes.
 - .5 Time, day, month, year.
 - .6 Control loop configuration changes for controller-based CDLs.
 - .7 Control loop tuning changes.
 - .8 Schedule changes.
 - .9 Changes, additions, or deletions, of points, graphics, for installed and future systems.
- .11 According to assigned user privileges (password definition) following functions are to be supported:
 - .1 Permit operator to terminate automatic (logic based) control and set value of field point to operator selected value. These values or settings to remain in effect until returned to automatic (logic based) control by operator.
 - .2 Requests for status, analog values, graphic displays, logs and controls to be through user interface screens.
- .12 Software and tools utilized to generate, modify and configure building controllers to be installed and operational on the OWS.
- .7 Dial-up host Module for off site OWSs.
 - .1 Operators at dial-up OWS to be able to perform control functions, report functions, data base generation and modification functions as described for OWS's connected via LAN. Provide routines to automatically answer calls and either file or display information sent from remote panels.
 - .2 Operator to be able to access remote buildings by selection of facility by its logical name. Dial-up module to maintain user-definable cross-reference of buildings and associated telephone numbers without manual dialing.
 - .3 Local OWS may serve as dial-up host for remotely connecting OWSs, remote controllers or networks. Alarms and data file transfers handled via dial-up transactions must not interfere with local LAN activity. LAN activity not to prevent work-station from handling incoming calls.
- .8 Message Handling Module - and Error Messages: to provide message handling for following conditions:
 - .1 Message and alarm buffering to prevent loss of information.

- .2 Error detection correction and retransmission to guarantee data integrity.
- .3 Informative messages to operator for data error occurrences, errors in keyboard entry, failure of equipment to respond to requests or commands and failure of communications between EMCS devices.
- .9 Access Control Module.
 - .1 Minimum 5 levels of password access protection to limit control, display, or data base manipulation capabilities. Following is preferred format of progression of password levels:
 - .1 Guest: no password data access and display only.
 - .2 Operator Level: full operational commands including automatic override.
 - .3 Technician: data base modifications.
 - .4 Programmer: data base generation.
 - .5 Highest Level : system administration - password assignment addition, modification.
 - .2 User-definable, automatic log-off timers from 1 to 60 min. to prevent operators leaving devices on-line inadvertently. Default setting = 3 minutes.
- .10 Trend Data Module: includes historical data collection utility, trend data utility, control loop plot utility. Each utility to permit operator to add trend point, delete trend point, set scan rate.
 - .1 Historical data collection utility: collect concurrently operator selected real or calculated point values at operator selectable rate 30-480 minutes. Samples to include for each time interval (time-stamped), minimum present value, maximum present value, and average present value for point selected. Rate to be individually selectable for each point. Data collection to be continuous operation, stored in temporary storage until removed from historical data list by operator. Temporary storage to have at least 6 month capacity.
 - .2 Trend data utility: continuously collect point object data variables for variables from building controllers as selected by operator, including at minimum; present value of following point object types - DI, DO, AI, AO set points value, calculated values. Trend data utility to have capacity to trend concurrently points at operator-selectable rate of 05seconds to 3600 seconds, individually selectable for selected value, or use of COSV detection. Collected trend data to be stored on minimum 96 h basis in temporary storage until removed from trend data list by operator. Option to archive data before overwriting to be available.
 - .3 Control loop plot utility: for AO Points provide for concurrent plotting of Measured value input - present value, present value of output, and AO setpoint. Operator selectable sampling interval to be selectable between 1 second to 20 seconds. Plotting utility to scroll to left as plot reaches right side of display window. Systems not supporting control loop plot as

- separate function must provide predefined groups of values. Each group to include values for one control loop display.
- .4 Trend data Module to include display of historical or trend data to OWS screen in X Y plot presentation. Plot utility to display minimum of 6 historical points or 6 trend points concurrently or 1 Control Loop Plot. For display output of real time trend data, display to automatically index to left when window becomes full. Provide plotting capabilities to display collected data based on range of selected value for (Y) component against time/date stamp of collected data for (X) component.
 - .5 Provide separate reports for each trend utility. Provide operator feature to specify report type, by point name and for output device. Reports to include time, day, month, year, report title, and operator's initials. Implement reports using report module. Ensure trend data is exportable to third party spreadsheet or database applications for PCs.
- .11 Report Module: reports for energy management programs, function totalization, analog/pulse totalization and event totalization features available at MCU level. Refer also to Section 25 30 01 - EMCS: Building Controllers.
- .1 Reports to include time, day, month, year, report title, operator's initials.
 - .2 Software to provide capability to:
 - .1 Generate and format reports for graphical and numerical display from real time and stored data.
 - .2 Print and store reports as selected by operator.
 - .3 Select and assign points used in such reports.
 - .4 Sort output by area, system, as minimum.
 - .3 Periodic/automatic report:
 - .1 Generate specified report(s) automatically including options of start time and date, interval between reports (hourly, daily, weekly, monthly), output device. Software to permit modifying periodic/automatic reporting profile at any time.
 - .2 Reports to include:
 - .1 Power demand and duty cycle summary: see application program for same.
 - .2 Disabled "Locked-out" point summary: include point name, whether disabled by system or by operator.
 - .3 Run time summary: summary of accumulated running time of selected equipment. Include point name, run time to date, alarm limit setting. Run time to accumulate until reset individually by operator.
 - .4 Summary of run time alarms: include point name, run time to date, alarm limit.

- .5 Summary of start/stop schedules: include start/stop times and days, point name.
- .6 Motor status summary.
- .4 Report types:
 - .1 Dynamic reports: system to printout or display of point object data value requested by operator. System to indicate status at time of request, when displayed, updated at operator selected time interval. Provide option for operator selection of report type, by point name, and/or output device. Ensure reports are available for following point value combinations:
 - .2 Points in accessible from this OWS (total connected for this location), multiple "areas".
 - .3 Area (points and systems in Area).
 - .4 Area, system (points in system).
 - .5 System (points by system type).
 - .6 System point (points by system and point object type).
 - .7 Area point (points by system and point object type).
 - .8 Point (points by point object type).
 - .5 Summary report: printout or display of point objet data value selected by operator. Report header to indicate status at time of request. Ensure reports are available on same basis as dynamic reports. Provide option as to report type, point name, output device.
 - .6 Include preformatted reports as listed in Event/Alarm Module.
- .12 Graphics Display Module:
 - .1 Provide capacity for 100% expansion of system graphics. Graphic interface to provide user with multiple layered diagrams for site, building in plan view, floor furniture plan view and building systems, overlaid with dynamic data appropriately placed and permitting direct operator interaction. Graphic interface to permit operator to start and stop equipment, change set points, modify alarm limits, override system functions and points from graphic system displays by use of touch screen.
 - .2 Dynamic data (temperature, humidity, flow, status) to be shown in actual schematic locations, to be automatically updated to show current values without operator intervention.
- .13 Event/Alarm Module : displays in window alarms as received and stored in General Event Log.
 - .1 Classify alarms as "critical", "cautionary", "maintenance". Alarms and alarm classifications to be designated by personnel requiring password level.

- .2 Presentation of alarms to include features identified under applicable report definitions of Report Module paragraph.
- .3 Alarm reports.
 - .1 Summary of points in critical, cautionary or maintenance alarm. Include at least point name, alarm type, current value, limit exceeded.
 - .2 Analog alarm limit summary: include point name, alarm limits, deviation limits.
 - .3 Summary of alarm messages: include associated point name, alarm description.
- .4 Software to notify operator of each occurrence of alarm conditions. Each point to have its own secondary alarm message.
- .5 System reaction to alarms: provide alarm annunciation by dedicated window (activated to foreground on receipt of new alarm or event) of OWS with visual and audible hardware indication. Acknowledgement of alarm to change visual indicator from flashing to steady state and to silence audible device. Acknowledgment of alarm to be time, date and operator stamped and stored in General Event Log. Steady state visual indicator to remain until alarm condition is corrected but must not impede reporting of new alarm conditions. Notification of alarm not to impede notification of subsequent alarms or function of Controller's/CDL. Do not allow random occurrence of alarms to cause loss of alarm or over-burden system. Do not allow acknowledgment of one alarm as acknowledgement of other alarms.
- .6 Controller network alarms: system supervision of controllers and communications lines to provide following alarms as minimum:
 - .1 Controller not responding - where possible delineate between controller and communication line failure.
 - .2 Controller responding - return to normal.
 - .3 Controller communications bad - high error rate or loss of communication.
 - .4 Controller communications normal - return to normal.
- .7 Digital alarm status to be interrogated every 2 seconds as minimum or be direct interrupting non-polling type (COV). Annunciate each non-expected status with alarm message.

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

- .1 Provide necessary power as required from local 120 V emergency power branch circuit panels for OWS's and peripheral equipment.
 - .1 Install tamper locks on breakers of circuit panels.
 - .2 Refer to UPS requirements stated under OWS Hardware in PART 2.

PART 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for building automation controllers including:

- .1 Master Control Unit (MCU).**
- .2 Local Control Unit (LCU).**
- .3 Equipment Control Unit (ECU).**
- .4 Terminal Control Unit (TCU).**

.2 Related Sections:

- .1 Section 25 05 01 - EMCS: General Requirements.**
- .2 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.**
- .3 Section 25 05 03 - EMCS: Project Record Documents.**
- .4 Section 25 30 02 - EMCS: Field Control Devices.**
- .5 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.**

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers, Inc. (ASHRAE).

- .1 ASHRAE 2011, Applications Handbook, SI Edition.**

.2 Canadian Standards Association (CSA International).

- .1 C22.2 No.205-M1983(R2009), Signal Equipment.**

.3 Institute of Electrical and Electronics Engineers (IEEE).

- .1 IEEE C37.90.1-12, Surge Withstand Capabilities (SWC) Tests for Relays and Relay Systems Associated with Electric Power Apparatus.**

1.3 DEFINITIONS

- .1 Acronyms and definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.4 SYSTEM DESCRIPTION

- .1 General: Network of controllers comprising of MCU('s), LCU('s), ECU('s) or TCU('s) to be provided to support building systems and associated sequence(s) of operations as detailed in these specifications.
 - .1 Provide sufficient controllers to meet intents and requirements of this section.
 - .2 Controller quantity, and point contents to be approved by Departmental Representative at time of preliminary design review.
 - .3 Controller to communicate over a BACnet network.
- .2 Controllers: stand-alone intelligent Control Units.
 - .1 Incorporate programmable microprocessor, non-volatile program memory, RAM, power supplies, as required to perform specified functions.
 - .2 Incorporate BACnet communication interface ports for communication to LANs to exchange information with other Controllers.
 - .3 Capable of interfacing with operator interface device.
 - .4 Execute its logic and control using primary inputs and outputs connected directly to its onboard input/output field terminations or slave devices, and without need to interact with other controller. Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).
 - .1 Secondary input used for reset such as outdoor air temperature may be located in other Controller(s).

1.5 DESIGN REQUIREMENTS

- .1 To include:
 - .1 Scanning of AI and DI connected inputs for detection of change of value and processing detection of alarm conditions.

- .2 Perform On-Off digital control of connected points, including resulting required states generated through programmable logic output.
 - .3 Perform Analog control using programmable logic, (including PID) with adjustable dead bands and deviation alarms.
 - .4 Control of systems as described in sequence of operations.
 - .5 Execution of optimization routines as listed in this section.
 - .6 Capability to create, delete and support BACnet objects.
- .2 Total spare capacity for MCUs and LCUs: at least 25 % of each point type distributed throughout the MCUs and LCUs.
 - .3 Field Termination and Interface Devices:
 - .1 To: CSA C22.2 No. 205-M1983 (R2009).
 - .2 Electronically interface sensors and control devices to processor unit.
 - .3 Include, but not be limited to, following:
 - .1 Programmed firmware or logic circuits to meet functional and technical requirements.
 - .2 Power supplies for operation of logics devices and associated field equipment.
 - .3 Lockable wall cabinet.
 - .4 Required communications equipment and wiring (if remote units).
 - .5 Leave controlled system in "fail-safe" mode in event of loss of communication with, or failure of, processor unit.
 - .6 Input Output interface to accept as minimum AI, AO, DI, DO functions as specified.
 - .7 Wiring terminations: use conveniently located screw type or spade lug terminals.
 - .4 AI interface equipment to:
 - .1 Convert analog signals to digital format with 12 bit analog-to-digital resolution.
 - .2 Provide for following input signal types and ranges:
 - .1 4 - 20 mA;
 - .2 0 - 10 V DC;
 - .3 100/1000 ohm RTD input;
 - .3 Meet IEEE C37.90.1-2012 surge withstand capability.

- .4 Have common mode signal rejection greater than 60 dB to 60 Hz.
- .5 Where required, dropping resistors to be certified precision devices which complement accuracy of sensor and transmitter range specified.
- .5 AO interface equipment:
 - .1 Convert digital data from controller processor to acceptable analog output signals using 12 bit digital-to-analog resolution.
 - .2 Provide for following output signal types and ranges:
 - .1 4 - 20 mA.
 - .2 0 - 10 V DC.
 - .3 Meet IEEE C37.90.1-2012 surge withstand capability.
 - .4 DI interface equipment:
 - .1 Able to reliably detect contact change of sensed field contact and transmit condition to controller.
 - .2 Meet IEEE C37.90.1-2012 surge withstand capability.
 - .3 Accept pulsed inputs up to 2 kHz.
- .6 DO interface equipment:
 - .1 Respond to controller processor output, switch respective outputs. Each DO hardware to be capable of switching up to 0.5 amps at 24 V AC.
 - .2 Switch up to 5 amps at 220 V AC using optional interface relay.
- .4 Controllers and associated hardware and software: operate in conditions of 0 degrees C to 44 degrees C and 20 % to 90 % non-condensing RH.
- .5 Controllers (MCU, LCU): mount in wall mounted cabinet with hinged, keyed-alike locked door.
 - .1 Provide for conduit entrance from top, bottom or sides of panel.
 - .2 ECUs and TCUs to be mounted in equipment enclosures or separate enclosures.
 - .3 Mounting details as approved by Departmental Representative for ceiling mounting.
- .6 Cabinets to provide protection from water dripping from above, while allowing sufficient airflow to prevent internal overheating.
- .7 Provide surge and low voltage protection for interconnecting wiring connections.

1.6 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures and Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
 - .1 Submit product data sheets for each product item proposed for this project.

1.7 MAINTENANCE PROCEDURES

- .1 Provide manufacturers recommended maintenance procedures for insertion in Section 25 05 03 - EMCS: Project Record Documents.

PART 2 PRODUCTS

2.1 MASTER CONTROL UNIT (MCU)

- .1 General: primary function of MCU is to provide co-ordination and supervision of subordinate devices in execution of optimization routines such as demand limiting or enthalpy control.
- .2 Include high speed communication LAN Port for Peer to Peer communications with OWS(s) and other MCU level devices.
 - .1 MCU must support BACnet.
- .3 Central Processing Unit (CPU).
 - .1 Processor to consist of minimum 32 bit microprocessor capable of supporting software to meet specified requirements.
 - .2 CPU idle time to be more than 30 % when system configured to maximum input and output with worst case program use.
 - .3 Minimum addressable memory to be at manufacturer's discretion but to support at least performance and technical specifications to include but not limited to:
 - .1 Non-volatile EEPROM to contain operating system, executive, application, sub-routine, other configurations definition software. Tape media not acceptable.

- .2 Battery backed (72 hour minimum capacity) RAM (to reduce the need to reload operating data in event of power failure) to contain CDLs, application parameters, operating data or software that is required to be modifiable from operational standpoint such as schedules, setpoints, alarm limits, PID constants and CDL and hence modifiable on-line through operator panel or remote operator's interface. RAM to be downline loadable from OWS.
- .4 Include uninterruptible clock accurate to plus or minus 5 secs/month, capable of deriving year/month/day/hour/minute/second, with rechargeable batteries for minimum 72 hour operation in event of power failure.
- .4 Local Operator Terminal (OT): Provide OT for each MCU unless otherwise specified in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.
 - .1 Mount access/display panel in MCU or in suitable enclosure beside MCU as approved by Departmental Representative.
 - .2 Support operator's terminal for local command entry, instantaneous and historical data display, programs, additions and modifications.
 - .3 Display simultaneously minimum of 16 point identifiers to allow operator to view single screen dynamic displays depicting entire mechanical systems. Point identifiers to be in English.
 - .4 Functions to include, but not be limited to, following:
 - .1 Start and stop points.
 - .2 Modify setpoints.
 - .3 Modify PID loop parameters.
 - .4 Override PID control.
 - .5 Change time/date.
 - .6 Add/modify/start/stop weekly scheduling.
 - .7 Add/modify setpoint weekly scheduling.
 - .8 Enter temporary override schedules.
 - .9 Define holiday schedules.
 - .10 View analog limits.
 - .11 Enter/modify analog warning limits.
 - .12 Enter/modify analog alarm limits.
 - .13 Enter/modify analog differentials.

- .5 Provide access to real and calculated points in controller to which it is connected or to other controller in network. This capability not to be restricted to subset of predefined "global points" but to provide totally open exchange of data between OT and other controller in network.
- .6 Operator access to OTs: same as OWS user password and password changes to automatically be downloaded to controllers on network.
- .7 Provide prompting to eliminate need for user to remember command format or point names. Prompting to be consistent with user's password clearance and types of points displayed to eliminate possibility of operator error.
- .8 Identity of real or calculated points to be consistent with network devices. Use same point identifier as at OWS's for access of points at OT to eliminate cross- reference or look-up tables.

2.2 LOCAL CONTROL UNIT (LCU)

- .1 Provide multiple control functions for typical built-up and package HVAC systems, hydronic systems and electrical systems.
- .2 Minimum of 16 I/O points of which minimum be 4 AOs, 4 AIs, 4 DIs, 4 DOs.
- .3 Points integral to one Building System to be resident on only one controller.
- .4 Microprocessor capable of supporting necessary software and hardware to meet specified requirements as listed in previous MCU article with following additions:
 - .1 Include minimum 2 interface ports for connection of local computer terminal.
 - .2 Design so that shorts, opens or grounds on input or output will not interfere with other input or output signals.
 - .3 Physically separate line voltage (70V and over) circuits from DC logic circuits to permit maintenance on either circuit with minimum hazards to technician and equipment.
 - .4 Include power supplies for operation of LCU and associated field equipment.
 - .5 In event of loss of communications with, or failure of, MCU, LCU to continue to perform control. Controllers that use defaults or fail to open or close positions not acceptable.
 - .6 Provide conveniently located screw type or spade lug terminals for field wiring.

2.3 TERMINAL/EQUIPMENT CONTROL UNIT (TCU/ECU)

- .1 Microprocessor capable of supporting necessary software and hardware to meet TCU/ECU functional specifications.
 - .1 TCU/ECU definition to be consistent with those defined in ASHRAE HVAC Applications Handbook section 45.
- .2 Controller to be connected to the BACnet network and provide access from EMCS OWS for setting occupied and unoccupied space temperature setpoints, flow setpoints, and associated alarm values, permit reading of sensor values, field control values (% open) and transmit alarm conditions to EMCS OWS.
- .3 VAV or other Air Terminal Controller.
 - .1 Microprocessor based controller with integral flow transducer, including software routines to execute PID algorithms, calculate airflow for integral flow transducer, measure temperatures, activate fan and control reheat. Sequence of operation to ASHRAE HVAC Applications Handbook.
 - .2 Controller to support point definition; in accordance with Section 25 05 01 - EMCS: General Requirements.
 - .3 Controller to operate independent of network in case of communication failure.
 - .4 Controller to include damper actuator and terminations for input and output sensors and devices.
 - .5 Coordinate provision of controller with section 23 36 00 Air Terminal Units.

2.4 SOFTWARE

- .1 General
 - .1 Include as minimum: operating system executive, communications, application programs, operator interface, and systems sequence of operation - CDL's.
 - .2 Include "firmware" or instructions which are programmed into ROM, EPROM, EEPROM or other non-volatile memory.
 - .3 Include initial programming of Controllers, for entire system.
- .2 Program and data storage.

- .1 Store executive programs and site configuration data in ROM, EEPROM or other non-volatile memory.
- .2 Maintain CDL and operating data including setpoints, operating constants, alarm limits in battery-backed RAM or EEPROM for display and modification by operator.
- .3 Programming languages.
 - .1 Program Control Description Logic software (CDL) using English like or graphical, high level, general control language.
 - .2 Structure software in modular fashion to permit simple restructuring of program modules if future software additions or modifications are required. GO TO constructs not allowed unless approved by Departmental Representative.
- .4 Operator Terminal interface.
 - .1 Operating and control functions include:
 - .1 Multi-level password access protection to allow user/manager to limit workstation control.
 - .2 Alarm management: processing and messages.
 - .3 Operator commands.
 - .4 Reports.
 - .5 Displays.
 - .6 Point identification.
- .5 Pseudo or calculated points.
 - .1 Software to provide access to value or status in controller or other networked controller in order to define and calculate pseudo point. When current pseudo point value is derived, normal alarm checks must be performed or value used to totalize.
 - .2 Inputs and outputs for process: include data from controllers to permit development of network-wide control strategies. Processes also to permit operator to use results of one process as input to number of other processes (e.g. cascading).
- .6 Control Description Logic (CDL):
 - .1 Capable of generating on-line project-specific CDLs which are software based, programmed into RAM or EEPROM and backed up to OWS. Departmental Representative must have access to these algorithms for modification or to be able to create new ones and to integrate these into CDLs on BC(s) from OWS.

- .2 Write CDL in high level language that allows algorithms and interlocking programs to be written simply and clearly. Use parameters entered into system (e.g. setpoints) to determine operation of algorithm. Operator to be able to alter operating parameters on-line from BC(s) to tune control loops.
 - .3 Perform changes to CDL on-line.
 - .4 Control logic to have access to values or status of points available to controller including global or common values, allowing cascading or interlocking control.
 - .5 Energy optimization routines including enthalpy control, supply temperature reset, to be LCU or MCU resident functions and form part of CDL.
 - .6 MCU to be able to perform following pre-tested control algorithms:
 - .1 Two position control.
 - .2 Proportional Integral and Derivative (PID) control.
 - .7 Control software to provide ability to define time between successive starts for each piece of equipment to reduce cycling of motors.
 - .8 Provide protection against excessive electrical-demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
 - .9 Power Fail Restart: upon detection of power failure system to verify availability of Emergency Power as determined by emergency power transfer switches and analyze controlled equipment to determine its appropriate status under Emergency power conditions and start or stop equipment as defined by I/O Summary. Upon resumption of normal power as determined by emergency power transfer switches, MCU to analyze status of controlled equipment, compare with normal occupancy scheduling, turn equipment on or off as necessary to resume normal operation.
- .7 Event and Alarm management: use management by exception concept for Alarm Reporting. This is system wide requirement. This approach will insure that only principal alarms are reported to OWS. Events which occur as direct result of primary event to be suppressed by system and only events which fail to occur to be reported. Such event sequence to be identified in I/O Summary and sequence of operation. Examples of above are, operational temperature alarms limits which are exceeded when main air handler is stopped, or General Fire condition shuts air handlers down, only Fire alarm status shall be reported. Exception is, when air handler which is supposed to stop or start fails to do so under event condition.
 - .8 Energy management programs: include specific summarizing reports, with date stamp indicating sensor details which activated and or terminated feature.

- .1 MCU in coordination with subordinate LCU, TCU, ECU to provide for the following energy management routines:
 - .1 Time of day scheduling.
 - .2 Calendar based scheduling.
 - .3 Holiday scheduling.
 - .4 Temporary schedule overrides.
 - .5 Optimal start stop.
 - .6 Night setback control.
 - .7 Enthalpy (economizer) switchover.
 - .8 Peak demand limiting.
 - .9 Temperature compensated load rolling.
 - .10 Fan speed/flow rate control.
 - .11 Heating and cooling mediums temperature reset.
 - .12 Night purge.
- .2 Programs to be executed automatically without need for operator intervention and be flexible enough to allow customization.
- .3 Apply programs to equipment and systems as specified or requested by the Departmental Representative.
- .9 Function/Event Totalization: features to provide predefined reports which show daily, weekly, and monthly accumulating totals and which include high rate (time stamped) and low rate (time stamped) and accumulation to date for month.
 - .1 MCUs to accumulate and store automatically run-time for binary input and output points.
 - .2 MCU to automatically sample, calculate and store consumption totals on daily, weekly or monthly basis for user-selected analog or binary pulse input-type points.
 - .3 MCU to automatically count events (number of times pump is cycled off and on) daily, weekly or monthly basis.
 - .4 Totalization routine to have sampling resolution of 1 min or less for analog inputs.
 - .5 Totalization to provide calculations and storage of accumulations up to 99,999.9 units (eg. kWh, litres, tonnes, etc.).
 - .6 Store event totalization records with minimum of 9,999,999 events before reset.

- .7 User to be able to define warning limit and generate user-specified messages when limit reached.

2.5 LEVELS OF ADDRESS

- .1 Upon operator's request, EMCS to present status of any single 'point', 'system' or point group, entire 'area', or entire network on printer or OWS as selected by operator.
 - .1 Display analog values digitally to 1 place of decimals with negative sign as required.
 - .2 Update displayed analog values and status when new values received.
 - .3 Flag points in alarm by blinking, reverse video, different colour, bracketed or other means to differentiate from points not in alarm.
 - .4 Updates to be change-of-value (COV)-driven or if polled not exceeding 2 second intervals.

2.6 POINT NAME SUPPORT

- .1 Controllers (MCU, LCU) to support point naming convention as defined in Section 25 05 01 - EMCS: General Requirements.

PART 3 EXECUTION

3.1 LOCATION

- .1 Location of Controllers to be approved by Departmental Representative.

3.2 INSTALLATION

- .1 Install Controllers in secure locking enclosures or as directed by Departmental Representative.

- .2 Provide necessary power from local 120 V branch circuit panel for equipment.
- .3 Install tamper locks on breakers of circuit breaker panel.
- .4 Use uninterruptible Power Supply (UPS) and emergency power when equipment must operate in emergency and co-ordinating mode.
- .5 Install Main Operator Terminal in location as coordinated with Department Representative.

PART 1 GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Control devices integral to the Building Energy Monitoring and Control System (EMCS): transmitters, sensors, controls, meters, switches, transducers, dampers, damper operators, valves, and valve actuators.
 - .2 Power wiring from 120V power panels to EMCS field panels, step-down transformers, DC power supplies as required for control devices.
 - .3 Related Sections:
 - .1 Section 01 73 00 - Execution.
 - .2 Section 07 84 00 - Firestopping.
 - .3 Section 23 33 15 - Dampers - Operating.
 - .4 Section 25 01 11 - EMCS: Start-Up, Verification and Commissioning.
 - .5 Section 25 05 01 - EMCS: General Requirements.
 - .6 Section 25 05 02 - EMCS: Shop Drawings, Product Data and Review Process.
 - .7 Section 25 05 54 - EMCS: Identification.
 - .8 Section 25 90 01 - EMCS: Site Requirements Applications and Systems Sequences of Operation.
 - .9 Section 26 05 00 - Common Work Results - For Electrical.
 - .10 Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI).
 - .1 ANSI C12.7-2005, Requirements for Watthour Meter Sockets.
 - .2 ANSI/IEEE C57.13-2008, Standard Requirements for Instrument Transformers.
- .2 American Society for Testing and Materials International, (ASTM).

- .1 ASTM B 148-2014, Standard Specification for Aluminum-Bronze Sand Castings.
- .3 National Electrical Manufacturer's Association (NEMA).
 - .1 NEMA 250-2008, Enclosures for Electrical Equipment (1000 Volts Maximum).
- .4 Air Movement and Control Association, Inc. (AMCA).
 - .1 AMCA Standard 500-D-12, Laboratory Method of Testing Dampers For Rating.
- .5 Canadian Standards Association (CSA International).
 - .1 CSA-C22.1-12, Canadian Electrical Code, Part 1 (21th Edition), Safety Standard for Electrical Installations.

1.3 DEFINITIONS

- .1 Acronyms and Definitions: refer to Section 25 05 01 - EMCS: General Requirements.

1.4 SUBMITTALS

- .1 Submit shop drawings and manufacturer's installation instructions in accordance with Section 25 05 02 - EMCS: Submittals and Review Process.
- .2 Pre-Installation Tests.
 - .1 Submit samples at random from equipment shipped, as requested by Departmental Representative for testing before installation. Replace devices not meeting specified performance and accuracy.
- .3 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions for specified equipment and devices.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Control devices of each category to be of same type and manufacturer.
- .2 External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, heat resistant, assembly.
- .3 Operating conditions: 0 - 32 degrees C with 10 - 90 % RH (non-condensing) unless otherwise specified.
- .4 Terminations: use standard conduit box with slot screwdriver compression connector block unless otherwise specified.
- .5 Transmitters and sensors to be unaffected by external transmitters including walkie-talkies.
- .6 Account for hysteresis, relaxation time, maximum and minimum limits in applications of sensors and controls.
- .7 Outdoor installations: use weatherproof construction in NEMA 4 enclosures.
- .8 Devices installed in user occupied space not exceed Noise Criteria (NC) of 35. Noise generated by any device must not be detectable above space ambient conditions.
- .9 Range: including temperature, humidity, pressure, as indicated in I/O summary in Section 25 90 01 - EMCS: Site Requirements, Applications and System Sequences of Operation.

2.2 TEMPERATURE SENSORS

- .1 General: except for room sensors to be resistance or thermocouple type to following requirements:
 - .1 Thermocouples: limit to temperature range of 200 degrees C and over.
 - .2 RTD's: 100 or 1000 ohm at 0 degrees C (plus or minus 0.2 ohms) platinum element with strain minimizing construction, 3 integral anchored leadwires. Coefficient of resistivity: 0.00385 ohms/ohm degrees C.

- .3 Sensing element: hermetically sealed.
- .4 Stem and tip construction: copper or type 304 stainless steel.
- .5 Time constant response: less than 3 seconds to temperature change of 10 degrees C.
- .6 Immersion wells: NPS 3/4, stainless steel spring loaded construction, with heat transfer compound compatible with sensor. Insertion length 150 mm.
- .2 Room temperature sensors and display wall modules.
 - .1 Room temperature sensing and display wall module.
 - .1 LCD display to show space temperature and temperature setpoint.
 - .2 Buttons for occupant selection of temperature setpoint and occupied/unoccupied mode.
 - .3 Jack connection for plugging in laptop personal computer contractor supplied zone terminal unit contractor supplied palm compatible handheld device for access to zone bus.
 - .4 Integral thermistor sensing element 10,000 ohm at 24 degrees.
 - .5 Accuracy 0.2 degrees C over range of 0 to 70 degrees C.
 - .6 Stability 0.02 degrees C drift per year.
 - .7 Separate mounting base for ease of installation.
- .3 Duct temperature sensors:
 - .1 General purpose duct type: suitable for insertion into ducts at various orientations, insertion length 460 mm or as indicated.
 - .2 Averaging duct type: incorporates numerous sensors inside assembly which are averaged to provide one reading. Minimum insertion length 6000 mm. Bend probe at field installation time to 100 mm radius at point along probe without degradation of performance.
- .4 Outdoor air temperature sensors:
 - .1 Outside air type: complete with probe length 100 - 150 mm long, non-corroding shield to minimize solar and wind effects, threaded fitting for mating to 13 mm conduit, weatherproof construction in NEMA 4 enclosure.

2.3 TEMPERATURE TRANSMITTERS

- .1 Requirements:
 - .1 Input circuit: to accept 3-lead, 100 or 1000 ohm at 0 degrees C, platinum resistance detector type sensors.
 - .2 Power supply: 24 V DC into load of 575 ohms. Power supply effect less than 0.01 degrees C per volt change.
 - .3 Output signal: 4 - 20 mA into 500 ohm maximum load.
 - .4 Input and output short circuit and open circuit protection.
 - .5 Output variation: less than 0.2 % of full scale for supply voltage variation of plus or minus 10 %.
 - .6 Combined non-linearity, repeatability, hysteresis effects: not to exceed plus or minus 0.5 % of full scale output.
 - .7 Maximum current to 100 or 1000 ohm RTD sensor: not to exceed 25 mA.
 - .8 Integral zero and span adjustments.
 - .9 Temperature effects: not to exceed plus or minus 1.0 % of full scale/50 degrees C.
 - .10 Long term output drift: not to exceed 0.25 % of full scale/ 6 months.
 - .11 Transmitter ranges: select narrowest range to suit application from following:
 - .1 Minus 50 degrees C to plus 50 degrees C, plus or minus 0.5 degrees C.
 - .2 0 to 100 degrees C, plus or minus 0.5 degrees C.
 - .3 0 to 50 degrees C, plus or minus 0.25 degrees C.
 - .4 0 to 25 degrees C, plus or minus 0.1 degrees C.
 - .5 10 to 35 degrees C, plus or minus 0.25 degrees C.

2.4 HUMIDITY SENSORS

- .1 Room and Duct Requirements:
 - .1 Range: 5 - 90 % RH minimum.
 - .2 Operating temperature range: 0 - 60 degrees C.
 - .3 Absolute accuracy:

- .1 Duct sensors: plus or minus 3 %.
- .2 Room sensors: plus or minus 2 %.
- .4 Sheath: stainless steel with integral shroud for specified operation in air streams of up to 10 m/s.
- .5 Maximum sensor non-linearity: plus or minus 2% RH with defined curves.
- .6 Room sensors: locate in air stream near RA grille wall mounted as indicated.
- .7 Duct mounted sensors: locate so that sensing element is in air flow in duct.
- .2 Outdoor Humidity Requirements:
 - .1 Range: 0 - 100 % RH minimum.
 - .2 Operating temperature range: -40 - 50 degrees C.
 - .3 Absolute accuracy: plus or minus 2 %.
 - .4 Temperature coefficient: plus or minus 0.03%RH/ degrees C over 0 to 50 degrees C.
 - .5 Must be unaffected by condensation or 100% saturation.
 - .6 No routine maintenance or calibration is required.

2.5 HUMIDITY TRANSMITTERS

- .1 Requirements:
 - .1 Input signal: from RH sensor.
 - .2 Output signal: 4 - 20 mA onto 500 ohm maximum load.
 - .3 Input and output short circuit and open circuit protection.
 - .4 Output variations: not to exceed 0.2 % of full scale output for supply voltage variations of plus or minus 10 %.
 - .5 Output linearity error: plus or minus 1.0% maximum of full scale output.
 - .6 Integral zero and span adjustment.
 - .7 Temperature effect: plus or minus 1.0 % full scale/ 6 months.
 - .8 Long term output drift: not to exceed 0.25 % of full scale output/ 6 months.

2.6 PRESSURE TRANSDUCERS

.1 Requirements:

- .1 Combined sensor and transmitter measuring pressure.
 - .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
- .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
- .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
- .5 Temperature effects: not to exceed plus or minus 1.5 % full scale/ 50 degrees C.
- .6 Over-pressure input protection to at least twice rated input pressure.
- .7 Output short circuit and open circuit protection.
- .8 Accuracy: plus or minus 1 % of Full Scale.

2.7 DIFFERENTIAL PRESSURE TRANSMITTERS

.1 Requirements:

- .1 Internal materials: suitable for continuous contact with industrial standard instrument air, compressed air, water, steam, as applicable.
- .2 Output signal: 4 - 20 mA into 500 ohm maximum load.
- .3 Output variations: less than 0.2 % full scale for supply voltage variations of plus or minus 10 %.
- .4 Combined non-linearity, repeatability, and hysteresis effects: not to exceed plus or minus 0.5 % of full scale output over entire range.
- .5 Integral zero and span adjustment.
- .6 Temperature effects: not to exceed plus or minus 1.5 % full scale/50 degrees C.
- .7 Over-pressure input protection to at least twice rated input pressure.
- .8 Output short circuit and open circuit protection.

- .9 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.8 STATIC PRESSURE SENSORS

- .1 Requirements:
 - .1 Multipoint element with self-averaging manifold.
 - .1 Maximum pressure loss: 160 Pa at 10 m/s. (Air stream manifold).
 - .2 Accuracy: plus or minus 1 % of actual duct static pressure.

2.9 STATIC PRESSURE TRANSMITTERS

- .1 Requirements:
 - .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
 - .2 Calibrated span: not to exceed 150 % of duct static pressure at maximum flow.
 - .3 Accuracy: 0.4 % of span.
 - .4 Repeatability: within 0.5 % of output.
 - .5 Linearity: within 1.5 % of span.
 - .6 Deadband or hysteresis: 0.1 % of span.
 - .7 External exposed zero and span adjustment.
 - .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit

2.10 VELOCITY PRESSURE SENSORS

- .1 Requirements:
 - .1 Multipoint static and total pressure sensing element with self-averaging manifold with integral air equalizer and straightener section.
 - .2 Maximum pressure loss: 37 Pa at 10 m/s.
 - .3 Accuracy: plus or minus 1 % of actual duct velocity.

2.11 VELOCITY PRESSURE TRANSMITTERS

- .1 Requirements:
 - .1 Output signal: 4 - 20 mA linear into 500 ohm maximum load.
 - .2 Calibrated span: not to exceed 125 % of duct velocity pressure at maximum flow.
 - .3 Accuracy: 0.4 % of span.
 - .4 Repeatability: within 0.1 % of output.
 - .5 Linearity: within 0.5 % of span.
 - .6 Deadband or hysteresis: 0.1 % of span.
 - .7 External exposed zero and span adjustment.
 - .8 Unit to have 12.5 mm N.P.T. conduit connection. Enclosure to be integral part of unit.

2.12 DUCT AIR FLOW MEASURING STATIONS

- .1 The unit shall contain the number of sensing ports on each element and the number of elements per station to comply with ASHRAE Standard 111 for equal area traversing.
- .2 Capable of producing non-pulsating signals of true total and static pressure with an accuracy of 2% of actual flow for velocities as low as 0.5 m/s (100 fpm).
- .3 The pressure drop shall not exceed 45 Pa at 20m/s (4000fpm).
- .4 Anodized aluminum flow sensors factory mounted in 16 gauge galvanized steel frame

2.13 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES

- .1 Requirements:
 - .1 Internal materials: suitable for continuous contact with compressed air, water, steam, etc., as applicable.
 - .2 Adjustable setpoint and differential.

- .3 Switch: snap action type, rated at 120V, 15 amps AC or 24 V DC.
- .4 Switch assembly: to operate automatically and reset automatically when conditions return to normal. Over-pressure input protection to at least twice rated input pressure.
- .5 Accuracy: within 2 % repetitive switching.
- .6 Provide switches with isolation valve and snubber, where code allows, between sensor and pressure source.

2.14 TEMPERATURE SWITCHES

- .1 Requirements:
 - .1 Operate automatically. Reset automatically, except as follows:
 - .1 Low temperature detection: manual reset.
 - .2 High temperature detection: manual reset.
 - .2 Adjustable setpoint and differential.
 - .3 Accuracy: plus or minus 1 degrees C.
 - .4 Snap action rating: 120V, 15 amps or 24V DC as required. Switch to be DPST for hardwire and EMCS connections.
 - .5 Type as follows:
 - .1 Room: for wall mounting on standard electrical box with without protective guard as indicated.
 - .2 Duct, general purpose: insertion length = 460 mm.
 - .3 Thermowell: stainless steel, with compression fitting for NPS 3/4 thermowell. Immersion length: 100 mm.
 - .4 Low temperature detection: continuous element with 6000 mm insertion length, duct mounting, to detect coldest temperature in any 30 mm length.
 - .5 Strap-on: with helical screw stainless steel clamp.

2.15 SOLID STATE RELAYS

- .1 General:
 - .1 Relays to be socket or rail mounted.

- .2 Relays to have LED Indicator
- .3 Input and output Barrier Strips to accept 14 to 28 AWG wire.
- .4 Operating temperature range to be -20 degrees C to 70 degrees C.
- .5 Relays to be CSA Certified.
- .6 Input/output Isolation Voltage to be 4000 VAC at 25 degrees C for 1 second maximum duration.
- .7 Operational frequency range, 45 to 65 HZ.
- .2 Input:
 - .1 Control voltage, 3 to 32 VDC.
 - .2 Drop out voltage, 1.2 VDC.
 - .3 Maximum input current to match AO (Analog Output) board.
- .3 Output:
 - .1 AC or DC Output Model to suit application.

2.16 CURRENT TRANSDUCERS

- .1 Purpose: combined sensor/transducer, to measure line current and produce proportional signal in one of following ranges:
 - .1 4-20 mA DC.
 - .2 0-1 volt DC.
 - .3 0-10 volts DC.
 - .4 0-20 volts DC.
- .2 Frequency insensitive from 10 - 80 hz.
- .3 Accuracy to 0.5% full scale.
- .4 Zero and span adjustments. Field adjustable range to suit motor applications.
- .5 Adjustable mounting bracket to allow for secure/safe mounting inside MCC.

2.17 CURRENT SENSING RELAYS

- .1 Requirements:
 - .1 Suitable to detect belt loss or motor failure.
 - .2 Trip point adjustment, output status LED.
 - .3 Split core for easy mounting.
 - .4 Induced sensor power.
 - .5 Relay contacts: capable of handling 0.5 amps at 30 VAC / DC. Output to be NO solid state.
 - .6 Suitable for single or 3 phase monitoring. For 3-Phase applications: provide for discrimination between phases.
 - .7 Adjustable latch level.

2.18 MULTI-LEAF DAMPERS

- .1 Opposed blade for modulating service unless otherwise specified. Parallel blade type only for on/off service unless otherwise indicated, thermally insulated frame and blades unless otherwise noted.
- .2 Extruded aluminum (6063T5) frame, 2.03 mm thickness, extruded aluminum interlocking blades, complete with extruded silicon seals, spring stainless steel side seals, extruded aluminum frame.
- .3 Pressure fit self-lubricated bronze bearings.
- .4 Linkage: plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .5 Operator: to Section 25 30 02 - EMCS: Field Control Devices.
- .6 Performance:
 - .1 Leakage: in closed position to be less than 2% of rated air flow at 1000 Pa differential across damper.
 - .2 Pressure drop: at full open position to be less than 12 Pa differential across damper at 4 m/s.
- .7 Insulated aluminum dampers:

- .1 Frames: insulated with extruded polystyrene foam.
- .2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam.
- .8 Temperature range: dampers and scale materials to be suitable for -40°C to +68°C.
- .9 Acceptable Manufacturer: TAMCO 9000 SC, VENTEX, RUSKIN.

2.19 120 VOLT ELECTRONIC CONTROL DAMPER ACTUATORS

- .1 Requirements:
 - .1 Direct mount proportional type as indicated.
 - .2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
 - .3 Operator: size to control dampers against maximum pressure and dynamic closing/ opening pressure, whichever is greater.
 - .4 Power requirements: 10 VA maximum at 120 V AC.
 - .5 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

2.20 ELECTRONIC CONTROL DAMPER ACTUATORS

- .1 Requirements:
 - .1 Direct mount proportional type as indicated.
 - .2 Spring return for "fail-safe" in Normally Open or Normally Closed position as indicated.
 - .3 Operator: size to control dampers against maximum pressure and dynamic closing/ opening pressure, whichever is greater.
 - .4 Power requirements: 5 VA maximum at 24 V AC.
 - .5 Operating range: 0 - 10 V DC or 4 - 20 mA DC.
 - .6 For VAV box applications floating control type actuators may be used.

- .7 Damper actuator to drive damper from full open to full closed in less than 120 seconds.

2.21 CONTROL VALVES

- .1 Body: globe style or characterized ball.
 - .1 Sized to suit flow: linear, equal percentage, quick opening.
 - .2 Flow factor (KV) as required: CV in imperial units.
 - .3 Normally open/Normally closed, as indicated.
 - .4 Two or three ports as indicated.
 - .5 Leakage rate ANSI class IV, 0.01% of full open valve capacity.
 - .6 Packing easily replaceable.
 - .7 Stem, stainless steel.
 - .8 Plug and seat, stainless steel, brass, bronze.
 - .9 Disc, replaceable, material to suit application.
 - .10 NPS 2 and under:
 - .1 Screwed National Pipe Thread (NPT) tapered female connections.
 - .2 Valves to ANSI Class 250, valves to bear ANSI mark.
 - .3 Rangeability 50:1 minimum.
 - .11 NPS 2½ and larger:
 - .1 Flanged connections.
 - .2 Valves to ANSI Class 150 or 250 as indicated, valves to bear ANSI mark.
 - .3 Rangeability 100:1 minimum.
- .2 Butterfly Valves NPS 2 and larger:
 - .1 Body and ratings: to Section 23 05 23.05 BUTTERFLY VALVES.
 - .2 End connections: flanges, ANSI Class 150.
 - .3 Extended stem neck to provide adequate clearance for flanges and insulation.
 - .4 Pressure limit: bubble tight sealing to 170 kilopascals.
 - .5 Disc/vane: 316 stainless steel, aluminum bronze to ASTM B 148.

- .6 Seat: for service on chilled water PTFE (polytetrafluoroethylene), EPDM (ethylene propylene diene monomer). For service on steam and heating water PTFE, RTFE (reinforced PTFE).
- .7 Stem: 316 stainless steel.
- .8 Flow factor (KV) as indicated on control valve schedule: CV in imperial units.
- .9 Flow characteristic linear.
- .10 Maximum flow requirement as required to suit application.
- .11 Maximum pressure drop: pressure drop not to exceed one half of inlet pressure.
- .12 Normally open Normally closed, as indicated.
- .13 Valves are to be provided complete with mounting plate for installation of actuators.

2.22 ELECTRONIC / ELECTRIC VALVE ACTUATORS

- .1 Requirements:
 - .1 Construction: steel, cast iron, aluminum.
 - .2 Control signal: 0-10V DC or 4-20 mA DC.
 - .3 Positioning time: to suit application. 90 sec maximum.
 - .4 Fail to normal position as indicated.
 - .5 Scale or dial indication of actual control valve position.
 - .6 Size actuator to meet requirements and performance of control valve specifications.
 - .7 For interior and perimeter terminal heating and cooling applications floating control actuators are acceptable.
 - .8 Minimum shut-off pressure: as required.

2.23 PANELS

- .1 Free-standing wall mounted enamelled steel cabinets with hinged and key-locked front door.

- .2 Multiple panels as required indicated to handle requirements with additional space to accommodate 25% additional capacity as required by Departmental Representative without adding additional cabinets.
- .3 Panels to be lockable with same key.

2.24 WIRING

- .1 As per requirement of Division 26 where more stringent.
- .2 For wiring under 70 volts use FT6 rated wiring where wiring is not run in conduit. Other cases use FT4 wiring.
- .3 For 70V and above copper conductor with chemically cross-linked thermosetting polyethylene insulation rated RW90 and 6 2.28 V. Colour code to CSA 22.1.
- .4 Wiring must be continuous without joints.
- .5 Sizes:
 - .1 Field wiring to digital device: #18AWG 20AWG stranded twisted pair.
 - .2 Analog input and output: shielded #18 minimum solid copper #20 minimum stranded twisted pair.
 - .3 120V Power supply: to match or exceed breaker, size #12 minimum.
 - .4 Wiring for safeties/interlocks for starters, motor control centres, to be stranded, #14 minimum.
- .6 All wiring to be in rigid conduit, flexible and liquid tight flexible metal conduit to the requirement of Division 26.
- .7 Provide all power and low voltage control wiring as required for all EMCS controlled devices.
- .8 Provide all 120/24V transformer and DC power supplied as required for all EMCS devices.
- .9 Source 120 V power for controls from dedicated 120 V circuit in power panel EBP3 or as coordinated with Division 26 and the departmental representative.

2.25 AUXILIARY CONTROL DEVICES

- .1 Controls Transformers.
 - .1 Control transformers: 60 Hz, primary voltage to suit supply, 120 V single phase secondary, VA rating to suit load plus 20% margin.
- .2 DC Power supplies: To controls vendor requirements, CSA approved.

2.26 THERMOSTATS

- .1 Low-voltage space thermostat shall be 24 V, bimetal-operated, cury-switch type, with either adjustable or fixed anticipation eater, concealed setpoint adjustment, 13°C to 30°C setpoint range, 1°C maximum differential, and vented ABS plastic cover.
- .2 Line-voltage space thermostat shall be bimetal-actuated,open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator. UL listed for electrical rating, concealed setpoint adjustment, 13°C to 30°C setpoint range, 1°C maximum differential, and vented ABS plastic cover.
- .3 Low-limit thermostats shall be vapor pressure type with an element 6 m minimum length. Element shall respond to the lowest temperature sensed by an 30 cm section. the low-limit thermostat shall by manual reset only and be supplied as DPST.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install equipment, components so that manufacturer's and CSA labels are visible and legible after commissioning is complete.
- .2 Install field control devices in accordance with manufacturers recommended methods, procedures and instructions.

- .3 Temperature transmitters, humidity transmitters, current-to-pneumatic transducers, solenoid air valves, controllers, relays: install in NEMA I enclosure or as required for specific applications. Provide for electrolytic isolation in cases when dissimilar metals make contact.
- .4 Support field-mounted panels, transmitters and sensors on pipe stands or channel brackets.
- .5 Fire stopping: provide space for fire stopping in accordance with Section 07 84 00 - Firestopping. Maintain fire rating integrity.
- .6 Electrical:
 - .1 Complete installation in accordance with Section 26 05 00 - Common Work Results - For Electrical.
 - .2 Refer to control schematics and Sequences of Operation on drawings.
 - .3 Terminate wires with screw terminal type connectors suitable for wire size, and number of terminations.
 - .4 Install communication wiring in conduit.
 - .1 Provide complete conduit system to link Building Controllers, field panels and OWS(s).
 - .2 Conduit sizes to suit wiring requirements and to allow for future expansion capabilities specified for systems.
 - .3 Maximum conduit fill not to exceed 40%.
 - .4 Design drawings do not show conduit layout.
 - .5 Install all 120v power wiring to field control devices, control transformers, controllers and control panels as required for complete system operation. 120v power to originate from reserved circuits in electrical power panels. Coordinate with Division 26 for location of reserved circuits.
 - .6 Do not run exposed conduits in normally occupied spaces unless otherwise indicated or unless impossible to do otherwise. Departmental Representative to review before starting Work. All wiring must be in conduit.
- .7 Mechanical: supply and install;
 - .1 Pipe Taps.
 - .2 Wells, Control Valves and meters.
 - .3 Air flow stations, dampers, and other devices.

- .8 VAV Terminal Units: supply, install and adjust as required.
 - .1 Air probe, actuator and associated vav controls.
 - .2 Tubing from air probe to dp sensor as well as installation and adjustment of air flow sensors and actuators.
 - .3 Co-ordinate air flow adjustments with balancing trade.

3.2 TEMPERATURE AND HUMIDITY SENSORS

- .1 Stabilize to ensure minimum field adjustments or calibrations.
- .2 Readily accessible and adaptable to each type of application to allow for quick easy replacement and servicing without special tools or skills.
- .3 Outdoor installation:
 - .1 Protect from solar radiation and wind effects by non-corroding shields.
 - .2 Install in NEMA 4 enclosures.
- .4 Duct installations:
 - .1 Do not mount in dead air space.
 - .2 Locate within sensor vibration and velocity limits.
 - .3 Securely mount extended surface sensor used to sense average temperature.
 - .4 Thermally isolate elements from brackets and supports to respond to air temperature only.
 - .5 Support sensor element separately from coils, filter racks.
- .5 Averaging duct type temperature sensors.
 - .1 Install averaging element horizontally across the ductwork starting 300 mm from top of ductwork. Each additional horizontal run to be no more than 300 mm from one above it. Continue until complete cross sectional area of ductwork is covered. Use multiple sensors where single sensor does not meet required coverage.
 - .2 Wire multiple sensors in series for low temperature protection applications.
 - .3 Wire multiple sensors separately for temperature measurement.

- .4 Use software averaging algorithm to derive overall average for control purposes.
- .6 Thermowells: install for piping installations.
 - .1 Locate well in elbow where pipe diameter is less than well insertion length.
 - .2 Thermowell to restrict flow by less than 30%.
 - .3 Use thermal conducting paste inside wells.

3.3 PANELS

- .1 Arrange for conduit and tubing entry from top, bottom or either side.
- .2 Wiring and tubing within panels: locate in trays or individually clipped to back of panel.
- .3 Identify wiring and conduit clearly.

3.4 MAGNEHELIC PRESSURE INDICATORS

- .1 Install adjacent to fan system static pressure sensor and duct system velocity pressure sensor as reviewed by Departmental Representative.
- .2 Locations: as indicated as specified.

3.5 PRESSURE AND DIFFERENTIAL PRESSURE SWITCHES AND SENSORS

- .1 Install isolation valve and snubber on sensors between sensor and pressure source where code allows.
 - .1 Protect sensing elements on steam and high temperature hot water service with pigtail syphon between valve and sensor.

3.6 IDENTIFICATION

- .1 Identify field devices in accordance with Section 25 05 54 - EMCS: Identification.

3.7 AIR FLOW MEASURING STATIONS

- .1 Protect air flow measuring assembly until cleaning of ducts is completed.

3.8 TESTING AND COMMISSIONING

- .1 Calibrate and test field devices for accuracy and performance in accordance with Section 25 01 11 - EMCS: Start-up, Verification and Commissioning.

PART 1 GENERAL

1.1 SEQUENCING

- .1 Scheduled Operation:
 - .1 The EMCS shall reset zone heating and cooling setpoints, ventilation and auxiliary systems based on building operating mode. The operating modes are adjustable on a 365 day, 24 hour basis and shall be initially scheduled in conjunction with input received from Departmental Representative.
- .2 General Alarms:
 - .1 The EMCS shall alarm if any setpoint is exceeded by +/- 15% for a period of 30 minutes (adjustable).
- .3 All setpoints referenced in the control sequence shall be operator adjustable.
- .4 This sequence of operation requires various time delays. In each instance, provide separate delays for starting and stopping, enabling or disabling, etc. In all cases, an initial delay period is identified and shall be used as the initial setting for both time delay inputs unless noted otherwise. Unless specifically noted otherwise, all time delay periods are to be operator adjustable from the DDC system operating console.
- .5 All motorized control valves referred to in these sequences of operations shall be capable of operating at a rate of speed to move full stroke in either direction in not more than 60 seconds. Actual speed of operation shall be controllable at each valve through the DDC system programming.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 EXECUTION

3.1 SEQUENCE OF OPERATION

- .1 Test each system independently and then in unison with other related systems.
- .2 Sequence Variable Volume AHU Control - Multiple spaces with heating and cooling capabilities with DDC sensors.
 - .1 Application:
 - .1 Variable Volume AHU Control - Multiple Space with heating and cooling capabilities with DDC sensors. This section is applicable to Section 23 73 11 - Air Handling Units – Packaged.
 - .2 Applicable system:
 - .1 Variable Volume AHU Systems that supply ventilation to multiple spaces within a facility. FVAV boxes have DDC controllers with electronic space temperature sensors. The Static Pressure is controlled by supply and return fan modulation.
 - .3 Sequence of Operation:
 - .1 These sequences are to be executed by a combination of Packaged Equipment standard controls for integral cooling, heating, heat recovery and economized operation and supplemented by field EMCS controls to achieve the intended operation. Division 23 and Division 25 to coordinate for provision of fully functional system.
 - .2 The occupied versus unoccupied mode shall be dictated based on activation of an override pushbutton or a time-of-day schedule.
 - .4 Occupied Mode:
 - .1 On a signal from the EMCS dampers to open to preset minimum positions and damper status confirmed by position feedback, the supply, return fans and ERV-1 shall start. The economizer dampers shall modulate to satisfy the SAT sensor. Economizer dampers to utilize a ramping feature on initial start up.
 - .2 If after one minute (adjustable), no "on" status is sensed by the fans current sensing transducer the AHU's economizer dampers shall remain closed and an alarm shall be sent to the operator's workstation. On loss of fan "on" status, economizer dampers shall close.
 - .3 At the end of the occupied mode, the fans shall stop and the AHU's economizer dampers shall close.
 - .4 The economizer shall modulate toward minimum position based on heating / cooling demand from SAT setpoint. The economizer

shall modulate toward maintaining a minimum fresh air for ventilation in accordance with the following:

- .1 Fresh air flow based on monitoring of air flow station, mixing box dampers modulated to maintain minimum fresh air flow as indicated on AHU schedule.
- .5 When OAT > 21°C command the economizer dampers to minimum position.
- .6 Enable mechanical cooling when OAT > 13°C and cooling from economizer alone is not sufficient to meet SAT setpoint.
- .7 When mechanical cooling is required, the compressor shall be staged by the EMCS to maintain SAT setpoint. Cooling circuit to have minimum 3 stages. The packaged cooling system will provide safety and pressure control, modulate condenser fan operation. When heating is required the EMCS shall modulate the electric heating coil to maintain SAT setpoint.
- .8 Supply air temperature reset control: The SAT shall be reset in a linear fashion from OAT to the minimum and maximum values as follows:

OAT	SAT
-20°C	18°C
13°C	15°C

The supply air reset shall be overridden by a offset not to exceed plus or minus 3 (adjustable) degree C based on surveying the FVAV box positions. If anyone zone (adjustable) is at 100% cooling and space temperature not met then lower SAT by 1 degree C per minute (adjustable) to maximum offset.
- .9 SAT reset curve to be adjustable from Graphics Screen.
- .10 Maintain static pressure in duct by modulating the supply and return fans.
- .11 If the SAT falls below 4.4°C when the AHU is running, shut down the supply and return fans, close the economizer dampers, and indicate a low temperature alarm to the EMCS. Provide suitable alarm time delays to avoid false alarms on unit start-up.
- .12 Humidifier:
 - .1 When OAT < 10°C, enable the humidifier to operate after the AHU has run for 10 minutes.
 - .2 The humidifier shall modulate to maintain RA humidity at 30% RH.
- .13 The FVAV boxes will supply ventilation air to the spaces during occupied mode. On a call for heating the VAV boxes to modulate towards their minimum position. On a continued call for heat the Electric heating coil on shall modulate from 0%-100%. CUH-3

- shall activate when electric heating coil for FPB-3 calls for heat and shall turn off when the electric heating coil for FPB-3 turns off.
- .14 FPB-2 and FPB-6 shall also operate radiant in-floor electric heat as a second stage source of heating. The EMCS shall use anticipation logic to shut off the in-floor electric heat before the slab reaches 28°C (adjustable).
- .5 Unoccupied Mode:
- .1 During the unoccupied mode the AHU shall retain "off", the economizer shall be closed.
- .2 If a zone temperature falls below the unoccupied space setpoint the corresponding FVAV shall receive a signal from the EMCS to turn on, move the FVAV damper to the 'closed' position and modulate the electric heating coil to maintain unoccupied SAT.
- .3 The humidifier shall be shut off 10 minutes prior to start of unoccupied mode to allow cool down and shall retain off.
- .6 Filters:
- .1 FILTER: Provide analogue input to alarm dirty filters when differential pressure exceeds manufacturer's setting (adjustable).
- .3 Sequence ERV-3:
- .1 Application:
- .1 Constant volume ERV Control that provides air to the Cell Pavilion. Supply air cooling and heat is provided by a split system DX Coil and electric tempering coil.
- .2 Sequence of Operation:
- .1 These sequences are to be executed by a combination of packaged equipment standard controls for integral cooling, heating and supplemented by field EMCS controls to achieve the intended operation. Division 23 and Division 25 to coordinate for provision of fully functional system.
- .2 The ERV Shall run continuously at all times.
- .1 On a signal from the EMCS dampers shall open to preset minimum positions after damper status confirmed by position feedback, the supply and return fans of ERV-3 shall start and run continuously.
- .2 If after one minute, no "on" status is sensed by the ERV's current transducer, an alarm shall be sent to the operator's workstation. On loss of "on" status, fresh air and exhaust air dampers shall close.
- .3 Packaged ERV shall be monitored for status and common alarm. Alarm on filter D.P. outside of normal range.

- .4 When instructed to be turned "off" by user input ERV-3 fans shall stop and dampers shall close.
 - .5 Enable mechanical cooling when guard station space sensor calls for cooling. Allow for a temperature float of 2°C (adjustable).
 - .6 Enable CUH-4 when Guard station space sensor calls for heating. Allow for a temperature float of 2°C (adjustable).
 - .7 During heating conditions (OAT < 15). Pre-heat tempering coil ERV3-H shall modulate to maintain a SAT of 18°C.
 - .8 If the SAT falls below 4.4°C when the ERV is running, shut down the ERV fans, close associated dampers and indicate low temperature alarm to the EMCS.
- .4 Sequence ERV-2
- .1 Application
 - .1 Constant Volume ERV control the provides air to the Temporary Exhibits and Secure Exhibits. Heating is provided by an electric heating coil.
 - .2 Sequence of Operation
 - .1 These sequences are to be executed by a combination of packaged equipment standard controls for heating and supplemented by field EMCS controls to achieve the intended operation. Division 23 and Division 25 to coordinate for provision of fully functional system.
 - .2 The ERV shall run continuously at all times.
 - .1 On a signal from the EMCS dampers shall open to preset minimum positions, after damper status confirmed by position feedback the supply and return fans of ERV-2 shall start and run continuously.
 - .2 If after one minute, no "on" status is sensed by the ERV's current transducer, an alarm shall be sent to the operator's workstation. On loss of "on" status, fresh air and exhaust air dampers shall close.
 - .3 Packaged ERV shall be monitored for status and common alarm. Alarm on filter D.P. outside of normal range.
 - .4 When instructed to be "off" by user input ERV-2 fans shall stop and dampers shall close.
 - .5 During heating conditions (OAT <15°C) heating coil ERV2-H shall modulate to maintain a SAT of 20°C.
 - .6 If the SAT falls below 4.4°C when the ERV is running, shut down the ERV fans, close associated dampers and indicate low temperature alarm to the EMCS.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section Divisions 26, 27, 28 and 33.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-12, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
 - .2 CAN/CSA-C22.3 No. 7-10, Underground Systems.
 - .3 CAN/CSA-C22.3 No. 1-10, Overhead Systems.
 - .4 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
 - .2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .3 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.
 - .4 Conform to N.S.P.I. Distribution and Metering Standards.
 - .5 Installation to be in accordance with National Building Code of Canada (NBCC) and Local Regulations.

1.3 DEFINITIONS

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.4 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.

- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
- .3 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .4 Language operating requirements: provide identification nameplates and labels for control items in English.
- .5 Electrical permit required. Pay all associated fees.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS.
- .3 Submit for review single line electrical diagrams under plexiglass in glazed frames and locate.
 - .1 Electrical distribution system in main electrical room and electrical closet.
- .4 Submit for review fire alarm riser diagram, plan and zoning of building.
- .5 Shop drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Nova Scotia, Canada.
 - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
 - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
 - .4 Indicate of drawings clearances for operation, maintenance, and replacement of operating equipment devices.
- .6 Quality Control: in accordance with Section 01 45 00 - Quality Control.
 - .1 Provide CSA certified equipment and material.
 - .2 Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities for special approval before delivery to site.

- .3 Submit test results of installed electrical systems and instrumentation.
- .4 Permits and fees:
 - .1 Submit to Nova Scotia Department of Safety Services (Electrical Inspection Department) necessary number of drawings and specifications for examination and approval prior to commencement of Work.
 - .2 Pay associated fees.
 - .3 Notify Departmental Representative of changes required by Electrical Inspection Department prior to making changes
- .5 Submit, upon completion of Work, load balance report as described in PART 3 - LOAD BALANCE.
- .6 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.
- .7 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

1.6 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Provincial Territorial Act respecting manpower vocational training and qualification.
 - .1 Employees registered in provincial apprentices program: permitted, under direct supervision of qualified licensed electrician, to perform specific tasks.
 - .2 Permitted activities: determined based on training level attained and demonstration of ability to perform specific duties.
- .3 Site Meetings:
 - .1 In accordance with Section 01 32 00 - Construction Progress Documentation.
 - .2 Site Meetings: as part of Manufacturer's Field Services described in appropriate NMS Section, schedule site visits, to review Work, at stages listed.
 - .1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.

- .2 Twice during progress of Work at 25% and 60% complete.
- .3 Upon completion of Work, after cleaning is carried out.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Material Delivery Schedule: provide Departmental Representative with schedule within 4 weeks after award of Contract.
- .2 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20 – Waste Managing and Disposal.

1.8 SYSTEM STARTUP

- .1 Instruct Departmental Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

1.9 OPERATING INSTRUCTIONS

- .1 Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.

- .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .4 Post instructions where directed.
- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.
- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- .1 Provide material and equipment in accordance with Section 01 61 00 - Product Requirements.
- .2 Material and equipment to be CSA certified. Where CSA certified material and equipment is are not available, obtain special approval from authority having jurisdiction inspection authorities before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
- .3 Factory assemble control panels and component assemblies. Full assembly shall be certified, component certification only will not be accepted.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.
- .2 Control wiring and conduit: in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings and Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

2.3 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of inspection authorities and Departmental Representative.
- .2 Porcelain enamel signs, minimum size 175 x 250 mm.

2.4 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for copper or aluminum conductors.

2.5 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates and labels as follows:
 - .1 Nameplates: lamicooid 3 mm thick plastic engraving sheet matt white finish face, black core, lettering accurately aligned and engraved into core mechanically attached with double face tape.
 - .2 Sizes as follows:

NAMEPLATE	SIZES		
Size 1	10 X 50mm	1 line	3mm high letters
Size 2	12 X 70mm	1 line	5mm high letters
Size 3	12 X 70mm	2 lines	3mm high letters
Size 4	20 X 90mm	1 line	8mm high letters
Size 5	20 X 90 mm	2 lines	5mm high letters
Size 6	25 X 100mm	1 line	12m high letters
Size 7	25 X 100mm	2 lines	6mm high letters

- .2 Labels: embossed plastic labels with 6mm high letters unless specified otherwise.
- .3 Wording on nameplates and labels to be approved by Departmental Representative prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate and label.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

- .6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. XX" as directed by Departmental Representative.
- .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .8 Terminal cabinets and pull boxes: indicate system and voltage characteristics.
- .9 Transformers: indicate capacity, primary and secondary voltages.
- .10 Switchboards and Panel boards: Indicate designated name of equipment, system and voltage characteristics.

2.6 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, numbered coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.7 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15m intervals.
- .3 Colours: 25mm wide prime colour and 20mm wide auxiliary colour.

	<u>Prime</u>	<u>Auxiliary</u>
up to 250V	Yellow	
up to 600V	Yellow	Green
up to 5kV	Yellow	Blue
up to 15kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
<u>Other Security Systems</u>	<u>Red</u>	<u>Yellow</u>

2.8 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical equipment "equipment green" finish to EEMAC Y1-2.
 - .2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CSA C22.3 No.1 and No. 7 except where specified otherwise.

3.2 NAMEPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: schedule 40 steel pipe, sized for free passage of conduit, and protruding 50mm.
- .2 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.4 LOCATION OF OUTLETS

- .1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .2 Do not install outlets back-to-back in wall; allow minimum 150mm horizontal clearance between boxes.
- .3 Change location of outlets at no extra cost or credit, providing distance does not exceed 300mm, and information is given before installation.
- .4 Locate light switches on latch side of doors.
 - .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.5 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centre line of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1200mm.
 - .2 Wall receptacles:
 - .1 General: 300mm.
 - .2 Above top of continuous baseboard heater: 200mm.
 - .3 Above top of counters or counter splash backs: 175mm.
 - .4 In mechanical rooms: 1200mm.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Telephone and interphone outlets: 300mm.
 - .5 Wall mounted telephone and interphone outlets: 1200mm.
 - .6 Fire alarm stations: 1200mm.
 - .7 Fire alarm horn/strobes, Fire alarm strobes: 2300mm.
 - .8 Television outlets: 300mm.
 - .9 Wall mounted speakers: 2300mm.
 - .10 Clocks: 2100mm.

- .11 Door bell push buttons, panic alarm push buttons: 1200mm.

3.6 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.7 FIELD QUALITY CONTROL

- .1 Load Balance:
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of work, load balance report as directed in PART 1 - SUBMITTALS: phase and neutral currents on panelboards and dry-core centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm system, communications and intrusion alarm.
 - .6 Insulation resistance testing:
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
 - .4 Medium voltage cables: withstand test as recommended by cable manufacturer.

- .3 Carry out tests in presence of Departmental Representative.
- .4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .5 Manufacturer's Field Services:
 - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.8 ARC FLASH HAZARD PROTECTION

- .1 Provide Arc Flash Hazard warning labels in accordance with Section 26 05 01 - Arc Flash Hazard Protection.

3.9 CLEANING

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

PART 1 GENERAL

1.1 WORK INCLUDED

- .1 For this building, electrical equipment shall conform to Canadian Electrical Code - 2012 requirements for electrical shock and arc flash hazard warning labels. Undertake electrical shock and arc flash study and analysis per CSA Z462 Workplace Electrical Safety 2012 to define Hazard Category and Flash Protection Boundary information.
- .2 Install warning labels. Warning labels to be self adhesive type in highly visible locations. The labels shall be made of durable permanent adhesive and outdoor vinyl material with UV inhibited colours (UV resistant).
- .3 Scope:
 - .1 Accurate electrical system single-line diagram as required by CSA Z462. Include the following on the single line diagram:
 - .1 Nameplate data for electrical components (e.g. transformers, etc.).
 - .2 Cable sizes, types and lengths between electrical equipment components.
 - .3 Utility source data. (Obtain required data from NSPI.)
 - .4 Verified overcurrent device settings.
 - .2 Short Circuit Study in accordance with ANSI standard C37 and IEEE standard 141-1993 (Red Book).
- .4 Coordination Study in accordance with IEEE 242-2001 (Buff Book) to determine the proper overcurrent device settings that will balance system reliability through selective coordination while minimizing the magnitude of an electrical arc flash hazard incident.
- .5 Incident Energy Study in accordance with the IEEE 1584-2004a, "IEEE Guide for Performing Arc Flash Hazard Calculations" in order to quantify the hazard for selection of personal protective equipment (PPE). Tables that assume fault current levels and clearing time for proper PPE selection are not acceptable.
- .6 Short circuit, protection coordination and arc flash hazard analyses shall be carried out utilizing SKM Power Tools 7. All electrical equipment shall be correctly identified and modelled within PTW program. The complete electronic project files shall be provided to Departmental Representative. The files shall include: project file symbol library, (.prj), component library, any additions to the PTW library files (.lib), data block single lines (.drw), TCC curves, generated report files (.rpt) and any other related files.

1.2 SUBMITTALS

- .1 Comprehensive report that includes:
 - .1 Report summary with analysis methodology, findings and recommendations.
 - .2 Summary of input data for utility source, equipment and cables.
 - .3 Available fault current at each equipment location with comparison to equipment rating.
 - .4 Overcurrent device settings (e.g. pick-up, time delay, TCC curve).
 - .5 Incident energy level (calories/cm²) for each equipment location and recommended PPE.
 - .6 Overcurrent device coordination curve including related section of the single-line diagram.
 - .7 Report shall be stamped and signed by professional engineer registered and licensed in Province Nova Scotia, Canada.
- .2 Labels:
 - .1 Installed warning labels (orange <40 cal/cm²) or danger label (red > 40 cal/cm²) in accordance with ANSI Z535.4-2002. The label must be readable in both indoor and outdoor environments for at least 3 years and contain the following information:
 - .1 Arc hazard boundary (centimeters).
 - .2 Working distance (centimeters).
 - .3 Arc flash incident energy at the working distance (calories/cm²).
 - .4 PPE category and description including the glove rating.
 - .5 Voltage rating of the equipment.
 - .6 Limited approach distance (centimeters).
 - .7 Restricted approach distance (centimeters).
 - .8 Prohibited approach distance (centimeters).
 - .9 Equipment/bus name.
 - .10 Date prepared.
 - .11 Arc flash hazard study preparer name and address.

PART 2 PRODUCTS

2.1 NOT USED

- .1 Not used.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Clean thoroughly enclosure surface prior to applying labels.
- .2 Install labels.

3.2 QUALITY ASSURANCE

- .1 Provide all necessary material, equipment, labour, and technical supervision to perform the arc flash hazard analysis.
- .2 Utilize engineers and technicians that are experienced and regularly perform electrical power system testing.
- .3 Personnel performing the arc flash analysis shall be trained and experienced in accordance with NEMA Training Specification concerning the apparatus and systems being evaluated.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 21 – Wires and Cables (0-1000 V).

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-C22.2 No. 18.4-04(R2009), Hardware For The Support Of Conduit, Tubing and Cable.
 - .2 CAN/CSA-C22.2 No.65-03(R2008), Wire Connectors (Tri-National Standard with UL 486A-486B and NMX-J-543-ANCE-03).
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2-1961, Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wire and box connectors and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wire and box connectors for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wire and box connectors from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Pressure type wire connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CAN/CSA-C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
 - .1 Connector body and stud clamp for stranded copper conductors.
 - .2 Clamp for copper bar.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper bar.
 - .5 Sized for conductors and bars as indicated.
- .4 Clamps or connectors for armoured cable, TECK cable, flexible conduit, as required to: CAN/CSA-C22.2 No.18.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and cables and:
 - .1 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CAN/CSA-C22.2 No.65.
 - .2 Install fixture type connectors and tighten to CAN/CSA-C22.2 No.65. Replace insulating cap.
 - .3 Install bushing stud connectors in accordance with EEMAC 1Y-2.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 – Waste Managing and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 20 – Wire and Connectors (0-1000 V).
- .2 Section 28 31 00.01 – Multiplex Fire Alarm System.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA C22.2 No. 0.3-09, Test Methods For Electrical Wires and Cables.
 - .2 CAN/CSA C22.2 No. 131-07(R2012), Type TECK 90 Cable.
 - .3 CAN/ULC-S101, Standard Methods of Fire Endurance Tests of Building Construction and Materials.

1.3 PRODUCT DATA

- .1 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.

PART 2 PRODUCTS

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.
- .2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE and RWU90 XLPE. Use RWU90 for outdoor installations.

2.2 TECK 90 CABLE

- .1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical and to CAN/CSA C22.2 No. 131. Rated for hazardous location in areas classified as hazardous.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Cross-linked polyethylene XLPE.
 - .2 Rating: 1000 V.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride, low flame spread/low gas emission (LFS/LGE), fire retardant to CSA C22.2 No. 0.3.
- .7 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 1200 mm centers, unless noted otherwise, and as required by Local Authority.
 - .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
 - .1 Watertight, approved for TECK cable.
 - .2 Rated for hazardous location in areas classified as hazardous.

2.3 ARMOURED CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Type: ACWU90 PVC flame retardant jacket over armour for this project wet locations.

- .5 Connectors: anti short connectors.
- .6 Install only for short (less than 3 m) length to lighting.

2.4 CONTROL CABLES

- .1 Type: 600 V stranded annealed copper conductors, sizes as indicated:
 - .1 Insulation: RW90 (x-link).
 - .2 Shielding: metallized tapes over conductors.
 - .3 Overall covering: thermoplastic jacket.

2.5 2-HOUR FIRE RATED CABLE (MINERAL-INSULATED CABLE)

- .1 Cable shall be solid copper conductors, magnesium oxide insulation and seamless copper sheath, rated 600 volts.
- .2 Number of conductors and size as indicated on drawing.
- .3 ULC rated and labeled as 2-hours fire-rated cable tested to ULC-S139.
- .4 Field installed termination kit approved for MI cable from the same manufacturer.
- .5 Approved material: Pentair System 1850.

2.6 2-HOUR FIRE RATED CABLE (MINERAL-INSULATED CABLE) FOR FIRE ALARM AND CONTROL SYSTEMS

- .1 Cable shall be solid copper conductors, magnesium oxide insulation and seamless copper sheath, rated 300 volts.
- .2 Conductors size as indicated on drawing.
- .3 ULC rated and labeled as 2-hours fire-rated cable tested to ULC-S139.
- .4 Field installed termination kit approved for MI cable from the same manufacturer.
- .5 Approved material: Pentair System 1850.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Install cable in trenches in accordance with Section 26 05 43.01 - Installation of Cables in Trenches and In Ducts.
- .2 Lay cable in cable trays in accordance with Section 26 05 36 - Cable Trays for Electrical Systems.
- .3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - (0-1000 V).
- .4 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .5 Conductor length for parallel feeders to be identical.
- .6 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .7 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.
- .8 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.
- .9 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
 - .2 In underground ducts in accordance with Section 26 05 43.01 - Installation of Cables in Trenches and in Ducts.
 - .3 Provide dedicated neutral for each branch circuit.

3.4 INSTALLATION OF TECK90 CABLE (0 -1000 V)

- .1 Group cables wherever possible on channels.
- .2 Install cable, securely supported by cable clamps.

3.5 INSTALLATION OF ARMOURED CABLES

- .1 Group cables wherever possible on channels.
- .2 Install for short (less than 3 meters) length to lighting luminaires.

3.6 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

3.7 INSTALLATION OF MINERAL-INSULATED CABLES

- .1 Support and secure 2-hours fire-rated cables every 1 m.
- .2 Run cable exposed.
- .3 Install 2-hours fire-rated cable in accordance with manufacturer's instruction.

- .4 Do not splice cables.
- .5 Installer must be trained and qualify for installation of mineral – insulated cables installation.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results – For Electrical.
- .2 Section 26 28 20 – Ground Fault Circuit Interrupters – Class “A”.
- .3 Section 27 05 26 - Grounding and Bonding For Communications Systems.

1.2 REFERENCES

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837-02, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2 CSA International
 - .1 CSA Z462-12, Workplace Electrical Safety.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Section in accordance with Section 01 78 10 – Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect grounding equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe.
- .2 Copper conductor: minimum 6 m long for each concrete encased electrode, bare, stranded, MHD, size as indicated.
- .3 Rod electrodes: copper clad steel 19 mm diameter by minimum 3 m long.
- .4 Grounding conductors: bare stranded copper, soft annealed, size as indicated.
- .5 Insulated grounding conductors: green, copper conductors, RW90, size as indicated. Minimum size #12 AWG.
- .6 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .7 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Thermit welded type conductor connectors.

- .5 Bonding jumpers, straps.
- .6 Pressure wire connectors.
- .7 Compression connectors.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for grounding equipment installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Run insulated ground wire in each conduit.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to conductive water main, electrodes, using copper welding by thermit process.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .8 Install flexible ground straps as required.
- .9 Install separate ground conductor to outdoor lighting standards.

- .10 Connect building structural steel and metal siding to ground by welding copper to steel.
- .11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

3.3 MAINTENANCE HOLES

- .1 Install conveniently located grounding stud, electrode, size as indicated stranded copper conductor in each maintenance hole.
- .2 Install ground rod in each maintenance hole so that top projects through bottom of maintenance hole. Provide with lug to which grounding connection can be made. Confirm ground resistance meets or exceeds Canadian Electrical Code minimum requirements.

3.4 ELECTRODES

- .1 Make ground connections to continuously conductive underground water pipe on street side of water meter.
- .2 Install water meter shunt.
- .3 Install rod, electrodes and make grounding connections as indicated.
- .4 Bond separate, multiple electrodes together.
- .5 Use size 4/0 AWG copper conductors for connections to electrodes.
- .6 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails.

3.5 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral of secondary 120/ 208 and 347/600 V systems.

3.6 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, fire pumps, elevators and escalators, distribution panels, outdoor lighting, cable trays.

3.7 GROUNDING BUS

- .1 Install copper grounding bus mounted on insulated supports on wall of main electrical room, room 121 and closet 120.
- .2 Ground items of electrical equipment in electrical room and IT equipment in communication equipment room to ground bus with individual bare stranded copper connections size 2/0AWG, unless noted otherwise.

3.8 COMMUNICATION SYSTEMS

- .1 Install grounding connections for telephone, sound, fire alarm, security systems, intercommunication systems as follows:
 - .1 Telephones: make telephone grounding system in accordance with telephone company's requirements.
 - .2 Sound, fire alarm, security systems, intercommunication systems as indicated and as per manufacturer's recommendations.
 - .3 Radio antenna as indicated.

3.9 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Departmental Representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

3.10 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 –Waste Managing and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 21 - Wires and Cables (0-1000 V).
- .2 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .3 Section 26 05 36 - Cable Trays For Electrical Systems.
- .4 Division 27 - Communications.
- .5 Division 28 – Electronic Safety and Security.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20 – Waste Managing and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.1 SUPPORT CHANNELS

- .1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted or suspended.
- .2 Hot dip galvanized (after fabrication) material for outdoor and in wet areas installation.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Secure equipment to masonry, tile and plaster surfaces with lead anchors or nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .4 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50 mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .5 Suspended support systems.
 - .1 Support individual cable or conduit runs with 6 mm dia threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6 mm dia threaded rod hangers where direct fastening to building construction is impractical.
- .6 For surface mounting of two or more conduits use channels at spacing in accordance with CSA C22.1.
- .7 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .8 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .9 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .10 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Departmental Representative.
- .11 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-12, Canadian Electrical Code, Part 1.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20 – Waste Managing and Disposal.

PART 2 PRODUCTS

2.1 JUNCTION AND PULL BOXES

- .1 Construction: welded steel enclosure. Enclosure to provide a degree of environmental protection equal to or higher than CSA Type 2 for indoor and 4X for outdoor.
- .2 Covers Flush Mounted: 25 mm minimum extension all around.
- .3 Covers Surface Mounted: screw-on turned edge covers.

2.2 CABINETS

- .1 Construction: welded sheet steel hinged door, handle, latch lock 2 keys and catch. Enclosure to provide a degree of environmental protection equal to or higher than CSA Type 2 for indoor and 4X for outdoor.
- .2 Type T Terminal: flush overlapping sides, mounting as indicated containing sheet steel backboard.

PART 3 EXECUTION

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.
- .3 Install terminal block as indicated in Type T cabinets.
- .4 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.
- .5 Vandal-proof stainless steel recessed junction box complete with vandal-proof stainless steel cover. Size as required.
 - .1 Refer to Appendix A for approved Tamperproof screws requirements.

3.2 IDENTIFICATION

- .1 Equipment Identification: to Section 26 05 00 - Common Work Results for Electrical.
- .2 Identification Labels: size 2 indicating system name, voltage and phase or as indicated.
- .3 All junction boxes: Indicate panel and circuit number.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .2 Section 26 27 26 - Wiring Devices.
- .3 Division 27 – Communications.
- .4 Division 28 – Electronic Safety and Security.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-12, Canadian Electrical Code, Part 1.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20 – Waste Managing and Disposal.

PART 2 PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 347 V outlet boxes for 347 V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 GALVANIZED STEEL OUTLET BOXES

- .1 One-piece electro-galvanized construction.
- .2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .3 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .4 Extension and plaster rings for flush mounting devices in finished walls.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 CONDUIT BOXES

- .1 Cast FS or FD copper-free aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.6 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 35mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Do not install reducing washers.
- .5 Vacuum clean interior of outlet boxes before installation of wiring devices.
- .6 Identify systems for outlet boxes as required.
- .7 Use FS or FD boxes for outdoor and in wet areas installation.
- .8 Conduit fittings (condulets) shall be accessible (not concealed).
- .9 Each receptacle to have its panel and circuit number identified on lamicaid nameplate above device.
- .10 Receptacles to be installed with grounds down.

.11 Dedicated neutrals required for all receptacle circuits.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 29 - Hangers and Supports for Electrical Systems.
- .2 Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.
- .3 Division 27 – Communications.
- .4 Division 28 – Electronic Safety and Security.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No. 18.1-03(R2009), Metallic Outlet Boxes.
 - .2 CSA C22.2 No. 45.1-07(R2012), Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56-04(R2009), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83-M1985(R2008), Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2-06(R2011), Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA No. 18.3-12, Conduit, Tubing and Cable Fittings.
 - .7 CSA C22.2 No. 211.1-06(R2011), Rigid Types EB1 and DB2/ES2 PVC Conduit.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product data: submit manufacturer's printed product literature, specifications and datasheets.
 - .1 Submit cable manufacturing data.
- .3 Quality assurance submittals:
 - .1 Test reports: submit certified test reports.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

- .3 Instructions: submit manufacturer's installation instructions.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20 – Waste Managing and Disposal.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

PART 2 PRODUCTS

2.1 CONDUITS

- .1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel threaded.
- .2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .4 Rigid PVC conduit: to CSA C22.2 No. 211.2. PVC conduits that are not concrete encased shall be Schedule 40.
- .5 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.
- .6 Concrete Encased Duct: Type DB2 to CSA C22.2 No. 211.1.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 53 mm and smaller.
- .2 Two hole steel straps for conduits larger than 53 mm.
- .3 Beam clamps to secure conduits to exposed steel work.
- .4 Channel type supports for two or more conduits in accordance with Section 26 05 29 - Hangers and Supports For Electrical Systems.

- .5 Threaded rods, 6 mm diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified.
Coating: same as conduit.
- .2 Ensure factory "ells" (condulets) where 90 degrees bends for 27 mm and larger conduits, except for communications systems.
- .3 Conduit fittings (condulets) are not permitted for communications systems.
- .4 Watertight connectors and couplings for EMT.
 - .1 Set-screws are not acceptable.
 - .2 Steel with insulated throat.

2.4 EXPANSION FITTINGS FOR RIGID CONDUIT

- .1 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- .2 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 FISH CORD

- .1 Polypropylene.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in unfinished areas.
- .3 Use rigid hot dipped galvanized steel threaded conduit where specified or subject to mechanical injury and in hazardous location areas.
- .4 Use epoxy coated conduit in corrosive areas.
- .5 Use electrical metallic tubing (EMT) indoors where not subject to mechanical injury.
- .6 Use rigid PVC conduit underground. Use DB2 ducts cast in concrete.
- .7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment.
- .8 Use explosion proof flexible connection for connection to explosion proof motors.
- .9 Install conduit sealing fittings in hazardous areas.
 - .1 Fill with compound.
- .10 Minimum conduit size for lighting and power circuits: 21 mm. Minimum conduit size for communications systems: 27 mm.
- .11 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .12 Mechanically bend steel conduit over 21 mm diameter.

- .13 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
- .14 Install fish cord in empty conduits.
- .15 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .16 Dry conduits out before installing wire.
- .17 Do not secure conduits to mechanical systems piping or ducts, suspended ceiling, etc.
- .18 Do not run conduits through hazardous areas or areas identified on drawings, unless conduit serves devices or equipment in that area.

3.3 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.5 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel.
 - .1 Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
 - .1 Use cold mastic between sleeve and conduit.
- .5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover, unless noted otherwise.
- .7 Organize conduits in slab to minimize cross-overs.

3.6 CONDUITS IN CAST-IN-PLACE SLABS ON GRADE

- .1 Run conduits 27 mm and larger below slab and encase in 75 mm concrete envelope.
 - .1 Provide 50 mm of sand over concrete envelope below floor slab.

3.7 CONDUITS UNDERGROUND

- .1 Slope conduits to provide drainage.
- .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.8 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.

- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 31 23 33.01 – Excavating, Trenching and Backfilling.
- .2 Section 33 65 73 - Concrete Encased Duct Banks.
- .3 Section 33 65 76 - Direct Buried Underground Cable Ducts.

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-Z809-08, Sustainable Forest Management.
- .2 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for cables and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect cables from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 CABLE PROTECTION

- .1 38 x 140 mm planks pressure treated with copper naphthenate or 5% pentachlorophenol solution, water repellent preservative.

2.2 MARKERS

- .1 Concrete type cable markers: 600 x 600 x 100 mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.
- .2 Polyethylene warning tape over full length of cable (raceway) route. Tape width of 75 mm with 4 mil tape thickness. Test on tape to read "CAUTION BURIED ELECTRIC LINE BELOW".

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for cable installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 CABLE INSTALLATION IN DUCTS

- .1 Install cables as indicated in ducts.
- .2 Do not pull spliced cables inside ducts.
- .3 Install multiple cables in duct simultaneously.
- .4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.
- .6 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .7 After installation of cables, seal duct ends with duct sealing compound.

3.3 MARKERS

- .1 Mark cable every 150 m along cable duct runs and changes in direction.
- .2 Where markers are removed to permit installation of additional cables, reinstall existing markers.
- .3 Lay concrete markers flat and centred over cable with top flush with finish grade.
- .4 Install warning tape over full length of ductbanks buried halfway between ductbank and grade level.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using qualified personnel.
 - .1 Include necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short circuits and grounds.
 - .1 Ensure resistance to ground of circuits is not less than 50 megohms.
- .5 Pre-acceptance tests:
 - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000 V megger on each phase conductor.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- .6 Acceptance Tests:
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .2 Ground shields, ground wires, metallic armour and conductors not under test.
 - .3 High Potential (Hipot) Testing.

- .1 Conduct hipot testing in accordance with manufacturer's recommendations.
- .4 Leakage Current Testing:
 - .1 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.
 - .2 Hold maximum voltage for specified time period by manufacturer.
 - .3 Record leakage current at each step.
- .7 Provide Departmental Representative with list of test results showing location at which each test was made, circuit tested and result of each test. Departmental Representative should witness test before receiving the results.
- .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 – Waste Managing and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

- .1 Repair damage to adjacent materials caused by cables installation.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 24 02 - Service Entrance Board.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI & C12.20-2010, Standard For Electricity Meters.
- .2 CSA International
 - .1 CAN3-C17-M84(R2008), Alternating - Current Electricity Metering.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for metering and switchboard instruments and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Include meter and instruments, outline dimensions, panel drilling dimensions and installation cutout template.
 - .3 Provide electrical data for instrument current and potential transformers.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect metering and switchboard instruments from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse packaging materials as specified in Construction Waste Management Plan Waste Reduction workplan in accordance with Section 01 74 20 – Waste Managing and Disposal.

PART 2 PRODUCTS

2.1 METER

- .1 Three-phase owners digital meter for power energy and utilities metering complete with communications capability.
- .2 Digital meter shall support the following applications:
 - .1 Power and Energy metering including: power, energy, demand and harmonics measurements. Suitable for revenue grade measurements to ANSI C12 for bill verification, and sub-metering applications.
 - .2 Power Quality Analysis.
 - .3 Cost allocation and billing.
 - .4 Demand and power factor control.
 - .5 Load studies and circuit optimization.
 - .6 Equipment Monitoring and Control including metering of utilities including high temperature hot water and domestic water supply.
 - .7 Preventative Maintenance alarms and event logging.
- .3 Digital meter technical features shall include:
 - .1 Capability to measure:
 - .1 True RMS 3-phase voltage, current and power.
 - .2 Instantaneous 3-phase voltage current, frequency, and power factor.
 - .3 Energy: bi-directional, absolute and net.
 - .4 Demand: rolling block, predicted, and thermal.

- .5 32 samples per cycle.
- .6 Harmonics: individual and total harmonic distortion up to the 15th.
- .7 Waveform recording.
- .8 K-Factor.
- .2 Communications requirements to include:
 - .1 Webmeter and MeterM@il allow distribution of metered data and alarms over the Internet. Provide server software and client software (3 single user licenses) if this is required.
 - .2 Ethernet port with EtherGate allows direct Ethernet-to-RS-485 data transfer.
 - .3 Built-in modem with ModemGate.
 - .4 Two RS-485 ports.
 - .5 One front panel optical port standard.
 - .6 Modbus RTU on serial, Ethernet, modem, and infrared ports.
 - .7 DNP 3.0 on serial, modem, and infrared ports.
 - .8 Modem call-back feature offers fast alarm response.
- .3 On-Board Data Logging on include:
 - .1 Scheduled or event-driven logging of up to 32 parameters.
 - .2 Sequence-of-events and min/max logging.
- .4 Setpoints for Control and Alarms to include:
 - .1 Setpoint on any parameter or condition.
 - .2 1 second operation.
- .5 Input and Outputs to include:
 - .1 4 digital inputs for status/counter functions.
 - .2 4 digital outputs for control/pulse functions.
 - .3 4 analog inputs and 4 analog outputs.
- .4 Digital meter to be programmable and settings to be adjustable by pushbutton panel integral to meter.
- .5 Indication of measurements, data logging, alarms and programming provided on digital readout panel integral to meter.

2.2 METER CABINET

- .1 Meter to be factory installed and wired in switchboard. Meter display and operator control functions to be front accessible.

2.3 TEST TERMINAL BLOCKS

- .1 Test terminal blocks: as required.

2.4 INSTRUMENTS TRANSFORMERS

- .1 Provide Current Transformers and Potential Transformers as required to meter a 347/600 VAC 3-Phase 4-Wire service. Current rating to match service entrance rating.
- .2 Instrument transformers in accordance with Section 26 22 19 - Control and Signal Transformers.

2.5 SHOP INSTALLATION

- .1 Install instrument transformers in separate compartment of switchboard.
- .2 Ensure adequate spacing between current transformers installed on each phase.
- .3 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources, electrical supplies.

2.6 EMCS INTERFACE

- .1 Metering system shall be capable of communicating with EMCS. Coordinate requirements with Division 25.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metering and switchboard instruments installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 METERING INSTALLATION

- .1 Install meters and instruments integral to the switchboard in location free from vibration and shock.
- .2 Make connections in accordance with diagrams.
- .3 Connect meter and instrument transformer cabinets to ground.
- .4 Locate meters as recommended by manufacturer.
 - .1 Use 35 mm conduit for interconnections.
 - .2 Use separate conduit for each set of current transformer connections, exclusive for metering.
- .5 Provide all necessary meter programming to ensure unit has full functionality as outlined in Part 2. Meter shall be programmed and wired to read status inputs from main circuit breaker, water pulse output and consumption via communication with water meter and alarms from transformer.

3.3 FIELD QUALITY CONTROL

- .1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical and in accordance with manufacturer's recommendations.
- .2 Perform simulated operation tests with metering, instruments disconnected from permanent signal and other electrical sources.
- .3 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources and electrical supplies.
- .4 Perform tests to obtain correct calibration.
- .5 Do not dismantle meters and instruments.

3.4 TRAINING

- .1 Provide four (4) hours training on site by factory trained technician and demonstrate set-up and programming of the meter.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 – Waste Managing and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.6 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by metering and switchboard instrument installation.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 20 - Waste Managing and Disposal.
- .3 Section 26 05 00 – Common Work Results – For Electrical.
- .4 Section 26 09 43 – Network Lighting Controls.
- .5 Section 26 50 00 – Lighting.

1.2 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
- .2 Test reports:
 - .1 Submit certified test reports indicating compliance with specifications for specified performance characteristics and physical properties.

1.4 DELIVERY, HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.

- .2 Waste Management and Disposal:
 - .1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20 - Waste Managing and Disposal.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Control system: by one manufacturer and assembled from compatible components.

2.2 VANDAL RESISTANT SWITCHES

- .1 Heavy duty, push-button switches rated 120 V. Vandal resistant, rugged design, protection against vandalism. Each pushbutton shall turn lights on and off. Pushbutton shall be pressed once to turn lights ON and pressed once to turn lights OFF.
- .2 Switches shall be mounted in vandal resistant stainless steel wall plate.
- .3 Refer to Appendix A for approved Tamperproof Screws.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Locate and install equipment in accordance with manufacturer's recommendations and as indicated.
- .2 This section applies only for lighting control devices for the following rooms: 201, 212, 210, 209, 203, 207, 205 and 204.
- .3 Install all cable in concealed conduit (no surface mounted conduit is allowed).

3.3 FIELD QUALITY

- .1 Site Tests:
 - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - For Electrical.
- .2 Actuate control units in presence of Departmental Representative to demonstrate lighting circuits are controlled as designated.
- .3 Schedule site visits to review Work.

3.4 ACCEPTABLE MANUFACTURER'S

- .1 Fail-Safe.

The specifications and drawings describe general performance requirements. The manufacturers shall provide all the required devices and equipment specific to their system in order to provide a fully operational system. The manufacturers shall provide information on the wiring requirements to the Contractor for line and low voltage.

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Equipment and installation for the low-voltage lighting control system.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 20 - Waste Managing and Disposal.
- .3 Section 26 05 00 - Common Work Results – For Electrical.
- .4 Section 26 09 25 - Vandal Resistant Lighting Control Devices.
- .5 Section 26 50 00 - Lighting

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Drawings to include electrical detail of controller, schematic of system, schedule and location of components.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20 - Waste Managing and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in accordance with Waste Management Plan.

- .4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 The lighting control system specified in this section shall provide time-based, sensor based, daylight harvesting, and manual lighting control without the use of any centrally hardwired switching equipment (relay panels). The system's control shall be exerted by directly switching lighting loads on and off and/or dimming 0-10 VDC dimmable drivers.
- .2 Completely integrated and programmable on site.
- .3 System shall have the ability to automatically change time delays and/or sensor function protocol, multiple times, in a predetermined schedule. Changes to the operation of the system can be made in real-time or scheduled via lighting control profiles. These profiles are outlines of settings that direct how a collection of devices function for a defined time period.
- .4 Individual lighting zones must continue to provide a user defined default level of lighting control in the event of a system communication failure or the management software becoming unavailable.
- .5 All devices within the control system shall be capable of being daisy-chain wired with CAT-5 low voltage cabling or data network low voltage cable.
- .6 All devices shall be low voltage.
- .7 Refer to Section 26 09 25 – Vandal Resistant Lighting Control Devices for lighting control requirement for the following rooms: 201, 212, 211, 210, 209, 203, 207, 205 and 204.

2.2 COMPONENTS

- .1 Network control device.

- .2 Routing devices that route communication and distribute power for up to 8 lighting zones (support 128 control devices).
- .3 Local user control switches and 0-10 V dimming switches.
- .4 Occupancy sensors.
- .5 Daylight control sensors.
- .6 Low voltage power packs.
- .7 Management Software.
- .8 Graphic touch screen control station.
- .9 Power supply.

2.3 NETWORK CONTROLLER

- .1 Shall recess into a two-gang switch box.
- .2 Shall provide user control via touch sensitive buttons which have no mechanical parts. Able to support 400 devices.
- .3 Shall have a backlit LCD panel.
- .4 Shall contain a real-time clock capable of synchronization with a network time authority.
- .5 Shall be capable of communicating on an Ethernet network with a fixed or DHCP assigned IP address.
- .6 Shall have RJ-45 ports for connection to system devices and RJ-45 ports for connection to Ethernet network.
- .7 Shall be powered with Class 2 low voltage power supplied locally via a directly-wired power supply.

2.4 CONTROL SWITCHES AND DIMMABLE CONTROL SWITCHES

- .1 Switch shall recess into single-gang switch box and fit a standard GFI opening.

- .2 Install switches in two gang back boxes c/w tile ring, as indicated on drawings.
- .3 Switch must meet local grounding requirements by providing a dedicated ground connection and grounding to mounting strap. Line and load wire connections shall be interchangeable. Sensor shall not allow current to pass to the load when sensor is in the unoccupied (Off) condition.
- .4 Switch shall have optional features for photocell/daylight override, and vandal resistant lens.
- .5 Switch shall be available with one to four integrated switching group with 0-10 V dimming as shown on drawing.
- .6 Communication shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors or data network low voltage cable with low voltage connectors.
- .7 Devices shall have at least two RJ-45 ports or connectors.

2.5 GRAPHIC WALL MOUNTED INTERFACE

- .1 The device shall have colour touchscreen of a minimum of 83.83 mm, be able to select between eight (8) predefined lighting sequences and operate 16 devices on/off or variable intensity (0-10 V dimming). Interface to have capacitive touch buttons with no moving mechanical parts.
- .2 Password protected.

2.6 OCCUPANCY SENSORS

- .1 Occupancy sensing technologies shall be completely passive meaning that they will not emit any radiation that is known to interfere with certain types of hearing aids, or electronic devices such as electronic white board readers.
- .2 Dual technologic (PIR and Microphonic).
- .3 Sensors shall be available with one or two occupancy "poles", each of which provides a programmable time delay.

- .4 Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors or low voltage data cable with low voltage connectors.
- .5 All sensors shall have two RJ-45 ports or two connectors.
- .6 Every sensor parameter shall be available and configured remotely from the software and locally via the device push-button.
- .7 Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 or low voltage cabling.
- .8 Coverage 8.5 m radius when mounted at 2.7 m.
- .9 Coverage 4.9 m to 10.9 m when mounted at 2.13 m to 4.5 m.

2.7 LOW VOLTAGE POWER PACK

- .1 Power Packs shall accept 120 VAC, be plenum rated, and provide Class 2 power to the system.
- .2 All devices shall have two RJ-45 ports or 2 low voltage connectors.
- .3 Every Power Pack parameter shall be available and configurable remotely from the software and locally via the device push-button.
- .4 Power Pack shall incorporate a Class 1 relay. Class 1 Relays shall provide 16 Amp switching of all load types, and be rated for 400,000 cycles.
- .5 Current monitoring.
- .6 Occupancy sensor tracking and photocell tracking.

2.8 DAYLIGHT SENSORS

- .1 Photocell sensing technologies shall be completely passive meaning that they will not emit any radiation that is known to interfere with certain types of hearing aids, or electronic devices such as electronic white board readers.
- .2 Automatically dims lighting via remote or local dimming output.

- .3 Sensors shall be available with one or two occupancy “poles”.
- .4 Communication and Class 2 low voltage power shall be delivered to each device via standard CAT-5 low voltage cabling with RJ-45 connectors or low voltage data cable with low voltage connectors.
- .5 All sensors shall have two RJ-45 ports or two low voltage connectors.
- .6 Every sensor parameter shall be available and configured remotely from the software and locally via the device push-button.
- .7 Sensors shall be able to function together with other sensors in order to provide expanded coverage areas by simply daisy-chain wiring together the units with CAT-5 or low voltage cabling.

2.9 MANAGEMENT SOFTWARE

- .1 Every device parameter (e.g. sensor time delay and photocell set-point) shall be available and configurable remotely from the software.
- .2 The following status monitoring information shall be made available from the software for all devices for which it is applicable: current occupancy status, remaining occupancy time delay(s), current photocell reading, current photocell inhibiting state, photocell transitions time remaining, current dim level, device temperature, and device relay state(s).
- .3 The following device identification information shall be made available from the software: model number, model description, serial number, manufacturing date code, custom label(s), and parent network device.
- .4 A printable network inventory report shall be available via the software.
- .5 All sensitive stored information and privileged communication by the software shall be encrypted.
- .6 All device firmware and system software updates must be available for automatic download and installation via the internet.
- .7 All lighting control profiles shall be stored on the network gateway device and on the software's host server.

- .8 Lighting control profiles shall be capable of being scheduled to run according to the following calendar options: start date/hour/minute, end date/hour/minute, and sunrise/sunset +/- timed offsets.
- .9 Sunrise/sunset times shall be automatically derived from location information using an astronomical clock.
- .10 Daylight savings time adjustments shall be capable of being performed automatically, if desired.
- .11 Lighting control profile schedules shall be capable of being given the following recurrence settings: daily, weekday, weekend, weekly, monthly, and yearly.
- .12 Software shall provide a graphical tool for easily viewing scheduled lighting control profiles.

2.10 LIGHTING CONTROL PROFILE

- .1 Real time modifications to operation modes, or scheduled modifications based on control profiles. Control profiles dictate how devices are controlled based on a time schedule.
- .2 Capacity to add control profiles to devices, zones, or group of zones.
- .3 All parameters to be able to be configured by control profiles.
- .4 All relays and variable controls to be able to be programmed to following or ignore occupancy detection, light levels, and local switches based on control profiles.
- .5 All profiles to be stored in the central control unit (gateway) and in system operator station.
- .6 Profiles to be able to be programmed based on the following options: Start (date/hour/minute), stop (date/hour/minute), sunrise/sunset, standard and daytime saving time.
- .7 Daytime hours to be based on the system's astronomical clock.
- .8 Profiles to be able to be modified based on the following variables: day, week, month, year.
- .9 A graphic interface will provide comprehensive tool for display of the profiles.

- .10 Initial system program to be done in accordance with Departmental Representative. Initial program shall have a fixed on/off and sweep time for every zone and or group of zone. On time 6h00, off time 18h00 and, sweep time at midnight.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 INSTALLATION

- .1 Locate and install equipment in accordance with manufacturer's recommendations and as indicated on drawings.
- .2 Install all cable in conduits. Do not use telecommunications cable tray.
- .3 All occupancy sensor, daylight sensor, power packs, and mounting devices should be mounted on junction box. No exposed wiring will be accepted.

3.3 FIELD QUALITY

- .1 Site tests:
 - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - for Electrical.
- .2 Actuate control units in presence of Departmental Representative to demonstrate lighting circuits are controlled as designated.
- .3 System to be programmed by manufacturer's representative. Schedule site visits to review work.

3.4 ACCEPTABLE MANUFACTURER'S

- .1 nLight.
- .2 Crestron.
- .3 Cooper.

The specifications and drawings describe general performance requirements. The manufacturers shall provide all the required devices and equipment specific to their system in order to provide a fully operational system. The manufacturers shall provide information on the wiring requirements to the Contractor for line and low voltage.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 28 - Grounding - Secondary.

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-C22.2 No.47-M90(R2012), Air-Cooled Transformers (Dry Type).
 - .2 CSA C9-02(R2011), Dry-Type Transformers.
 - .3 CAN/CSA-C802.2-12, Minimum Efficiency Values for Dry Type Transformers.
- .2 National Electrical Manufacturers Association (NEMA)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for dry type transformers and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Factory test reports should be provided for all transformers.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for dry type transformers for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect dry type transformers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 20 – Waste Managing and Disposal.

PART 2 PRODUCTS

2.1 DESIGN DESCRIPTION

- .1 Design 1.
 - .1 Type: ANN.
 - .2 3 phase, 600 V input, 120/208 V output, 60 Hz, rating as indicated on drawings.
 - .3 Voltage taps: standard.
 - .4 Insulation: Class 220, 150 degrees C temperature rise.
 - .5 Basic Impulse Level (BIL): standard.
 - .6 Hipot: standard.
 - .7 Average sound level: standard
 - .8 Impedance at 17 degrees C: standard
 - .9 Enclosure: CSA Type 3R, removable metal front panel.
 - .10 K-factors , K=13.
 - .11 Mounting: floor.

- .12 Finish: in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .13 Copper windings.
- .14 Winding configuration to be as noted on drawings.
- .15 Voltage Regulation to be 4% or better.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Label size: 7.
- .3 Nameplate wording: per Power Distribution Single Line Diagram Identification.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for dry type transformers installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Mount dry type transformers up to 75 kVA as indicated.
- .2 Mount dry type transformers above 75 kVA on floor.

- .3 Ensure adequate clearance around transformer for ventilation.
- .4 Install transformers in level upright position.
- .5 Remove shipping supports only after transformer is installed and just before putting into service.
- .6 Loosen isolation pad bolts until no compression is visible.
- .7 Make primary and secondary connections in accordance with wiring diagram.
- .8 Energize transformers after installation is complete.
- .9 Make conduit entry into bottom 1/3 of transformer enclosure.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 – Waste Managing and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by dry type transformers installation.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 09 23.01 - Metering and Switchboard Instruments.
- .2 Section 26 24 02 - Service Entrance Board.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C60044-07 (R2011), Instrument Transformers.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for control and signal transformers and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for control and signal transformers for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect control and signal transformers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 20 - Waste Managing and Disposal.

PART 2 PRODUCTS

2.1 POTENTIAL TRANSFORMERS (PT'S)

- .1 Primary voltage: 360V.
- .2 Secondary voltage: 120V.
- .3 Ratio: 3:1
- .4 Frequency: 60Hz.
- .5 Power factor: 0.7.
- .6 Continuous thermal rating: 200VA.
- .7 700V insulation class transformer.
- .8 Primary and secondary terminals: compression type with slot screws accessible from the top of the the transformer.
- .9 Core: high-grade, grain-oriented steel, wound core.
- .10 Primary and secondary coils: wound from coated copper.
- .11 Housing: polyurethane.

2.2 CURRENT TRANSFORMERS (CT'S)

- .1 Ratio: see drawing.
- .2 Frequency: 60Hz.
- .3 VA rating: 15VA.
- .4 600V insulation class transformer.
- .5 Terminals: brass studs with one flatwasher, lockwasher, and regular nut.
- .6 2 wire CT.
- .7 Metering accuracy: 0.3 B0.9.

2.3 MOUNTING BRACKETS

- .1 Potential transformers mounting brackets.
- .2 Fabricate brackets and channels from electrogalvanized code gauge painted steel.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for control and signal transformers installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install instrument transformers and ensure accessibility.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 - Waste Managing and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by control and signal transformers installation.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 09 23.01 - Metering and Switchboard Instruments.
- .2 Section 26 22 19 – Control and Signal Transformers.
- .3 Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .4 Section 26 41 00.03 – Surge Protection Devices.

1.2 REFERENCES

- .1 Service equipment to: CAN/CSA-C22.2 No. 31-04.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Indicate on shop drawings.
 - .1 Floor anchoring method and foundation template.
 - .2 Dimensioned cable entry and exit locations.
 - .3 Dimensioned position and size of bus.
 - .4 Overall length, height and depth.
 - .5 Dimensioned layout of internal and front panel mounted components.
- .3 Include time-current characteristic curves for circuit breakers and fuses.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for service entrance board for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.
- .2 Submit copies of maintenance data for complete assembly including components. Required number of copies as indicated in Section 01 78 10 - Closeout Submittals.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20 – Waste Managing and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

1.6 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Include:
 - .1 3 fuses for each type for instrument transformers.

PART 2 PRODUCTS

2.1 SERVICE ENTRANCE BOARD

- .1 Service: to CAN/CSA-C22.2 No.31.

- .2 Rating: 600 V, 3 phase, 4 wire, amps and short circuit current (rms symmetrical) ratings as indicated on drawings.
- .3 Equipment: dead front, size as indicated. Enclosure to provide a degree of environmental protection equal to or higher than CSA Type 2.
- .4 Instrument transformers (CT's and PT's) for Owners metering.
- .5 Owners meter: Integral in accordance with Section 26 09 23.01 - Metering and Switchboard Instruments.
- .6 Utility metering as indicated.
- .7 Distribution section.
- .8 Hinged access panels with captive knurled thumb screws.
- .9 Bus bars and main connections: 99.3% copper.
- .10 Identify phases with colour coding.

2.2 SERVICE ENTRANCE MAIN BREAKER TYPE 'LSI'

- .1 Moulded case circuit breakers to Section 26 28 16.02 – Moulded Case Circuit Breakers and as follows:
 - .1 Frame size: as indicated on drawing.
 - .2 Voltage and system: 347/600 V, 3 phase, 4 wire.
 - .3 Frequency: 60 Hz.
 - .4 Interrupting rating: as indicted on drawing.
 - .5 Trip unit:
 - .1 Solid state c/w:
 - .1 Long-time pickup and delay.
 - .2 Adjustable short-time pickup and delay.
 - .3 Instantaneous trip setting.

2.3 MOULDED CASE CIRCUIT BREAKERS

- .1 Moulded case circuit breakers to Section 26 28 16.02 - Moulded Case Circuit Breakers.

2.4 GROUNDING

- .1 Copper ground bus extending full width of enclosure and located at bottom.
- .2 Lugs at each end for size 2/0 grounding cable.

2.5 GROUND FAULT UNIT

- .1 Moulded case circuit breaker with integral ground fault unit in accordance with Section 26 28 16.02 - Moulded Case Circuit Breakers.

2.6 METERING

- .1 Mounting accessories and wiring for metering equipment:
 - .1 3 potential transformers.
 - .2 3 current transformers.
- .2 Instrument transformers in accordance with Section 26 22 19 - Control and Signal Transformers.
- .3 Utility metering compartment as indicated.

2.7 SURGE PROTECTION DEVICES

- .1 Surge protection devices in accordance with Section 26 41 00.03 - Surge Protection Devices.

2.8 FINISHES

- .1 Apply finishes in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .1 Service entrance board exterior: gray.

2.9 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplates:
 - .1 White plate, black letters, size 7.
 - .2 Complete board labelled: as indicated on drawings.
 - .3 Main disconnect labelled: "Main Breaker".
 - .4 Branch disconnects labelled: as indicated.

2.10 WARNING SIGNS

- .1 Provide potential electric shock and arc flash hazard warning sign in accordance with Section 26 05 00 - Common Work Results For Electrical.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Locate equipment as indicated on drawings.
- .2 Connect main secondary service to line terminals of main breaker.
- .3 Connect load terminals of distribution breaker's to feeders.
- .4 Check factory made connections for mechanical security and electrical continuity.
- .5 Run one grounding conductor ground bus to building ground.

- .6 Check trip unit settings against co-ordination study to ensure proper working and protection of components.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1
- .2 Section 26 28 16.02 - Moulded Case Circuit Breakers.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.29-11, Panelboards and Enclosed Panelboards.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Include on drawings:
 - .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect panelboards from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 20 –Waste Managing and Disposal.

PART 2 PRODUCTS

2.1 PANELBOARDS

- .1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .2 250 and 600 V panelboards: bus and breakers rated for 10,000 A (symmetrical) interrupting capacity unless indicated otherwise on drawings.
- .3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .5 Minimum of 2 flush locks for each panel board.
- .6 Two keys for each panelboard and key panelboards alike.

- .7 Copper bus with neutral of same ampere rating of mains.
- .8 Mains: suitable for bolt-on breakers.
- .9 Trim with concealed front bolts and hinges.
- .10 Trim and door finish: baked enamel as per colour schedule.
- .11 Enclosure to provide a degree of environmental protection equal to or higher than CSA Type 2.

2.2 BREAKERS

- .1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to Departmental Representative.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Nameplate for each panelboard size 4 engraved as indicated.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

2.4 WARNING SIGNS

- .1 Provide potential electric shock and arc flash hazard warning sign in accordance with Section 26 05 00 - Common Work Results for Electrical.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for panelboards installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Install surface mounted panelboards on plywood backboards in accordance with Section 06 10 00.01 - Rough Carpentry - Short Form. Where practical, group panelboards on common backboard.
- .3 Mount panelboards to height specified in Section 26 05 00 - Common Work Results for Electrical or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus with respective neutral identified.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 – Waste Managing and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by panelboards installation.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 28 20 - Ground Fault Circuit Interrupters - Class "A".
- .2 Section 26 41 00.03 - Surge Protection Devices.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CAN/CSA C22.2 No.42.1-00(R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA C22.2 No.55-M1986(R2012), Special Use Switches.
 - .4 CSA C22.2 No.111-10, General-Use Snap Switches (Bi-national standard, with UL 20).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect wiring devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan on accordance with Section 01 74 20 – Waste Managing and Disposal.

PART 2 PRODUCTS

2.1 SWITCHES

- .1 20 A, 120 V and 347 V, single pole, three-way, four-way switches to: CSA C22.2 No.55 and CSA C22.2 No.111.
- .2 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 Ivory toggle.
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads and heating loads.
- .4 Switches of one manufacturer throughout project.
- .5 Acceptable materials: Cooper, Hubbel, Pass & Seymour.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-20R, 125 V, 20 A, U ground, to: CSA C22.2 No.42 with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
- .2 Single receptacles CSA type 5-20 R, 125 V, 20 A, U ground with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Four back wired entrances, 2 side wiring screws.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.
- .5 Surge suppression receptacles in accordance with Section 26 41 00.03 - Surge Protection Devices.
- .6 Acceptable manufacturer: Cooper, Hubbell, Pass & Seymour.

2.3 COVER PLATES

- .1 Cover plates for wiring devices to: CSA C22.2 No.42.1.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Plastic white cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.
- .4 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Weatherproof cover plates shall be: one piece box and cover, heavy duty aluminum construction, install without removing electrical device, accepts standard receptacle configurations, factory installed cord opening gasket to keep water and insects out, approved for outdoor wet location.

- .6 Weatherproof cover plates shall be marked "Wet Location" after installation.
- .7 Provide vandal resistant cover plates, stainless steel finish, die-formed 10 ga.; back plate 10 ga. Install vandal resistant cover plate and back plate into the following rooms: 201, 204, 203, 205, 206, 207, 208, 202, 212, 211, 213, 210 and 209.
- .8 Refer to Appendix A for approved Tamperproof screw requirements.
- .9 Approved materials for vandal resistant cover plates:
 - .1 Fail-Safe 'SSB' Series.

2.4 FLOOR BOX

- .1 Floor box shall be recessed in concrete floor at locations indicated on drawings. Provide boxes with all necessary components to permit recessed installation in concrete floor.
 - .1 Box to maintain partition between power and communication cabling/ devices.
 - .2 Recessed box shall contain device outlets that will not obstruct the floor area. All wiring to be in conduit within concrete floor.
 - .3 Box shall be 4-Gang including up to four (4) receptacles or communication outlets. 16-Gauge galvanized stamped steel bases.
 - .4 Each floor box indicated on drawing shall have:
 - .1 One (1) duplex receptacle c/w coverplates, on one side.
 - .2 On the opposite side, two (2) for data CAT6 and one (1) for voice horizontal cabling (jack and face plates shall be provided). The rest shall be provision for future (face plate shall be provided).
 - .5 Include removable and reloadable dividers to permit custom configuration.
 - .6 Accept standard wall plate, 5-20R receptacles, and communication (CAT6).
 - .7 Fully finished interior to assist plugging and unplugging of devices.
 - .8 Knockouts in four sides, size from 21 mm to 53 mm trade size.
 - .9 Surface style cover with Solid Lid, die cast aluminum cover assembly designed to be used on top of floor covering and open 180° and lie flat on the surface. Colour shall be black and c/w cable door.
 - .10 cUL or CSA approved.

- .2 Acceptable material:
 - .1 Legrand "Evolution Series".
 - .2 Steel City.
 - .3 FSR.
 - .4 Hubbell.

2.5 SOURCE QUALITY CONTROL

- .1 Cover plates from one manufacturer throughout project.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common Work Results for Electrical unless indicated otherwise.

- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results for Electrical unless indicated otherwise.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Install GFI type receptacles as indicated.
- .3 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
- .4 Floor box:
 - .1 Install in room 102 as indicted.

3.3 WIRING

- .1 Connect wiring devices and switches to power circuit.
- .2 Utilize an individual, dedicated neutral conductor for each power circuit. Common or shared neutrals are not permitted.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 – Waste Managing and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 20 - Waste Managing System.
- .3 Section 01 78 10 - Closeout Submittals.
- .4 Section 26 05 00 – Common Work Results – For Electrical.
- .5 Section 26 05 21 – Wires and Cables (0-1000 V).
- .6 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.46-2013, Electric Air-Heaters.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit product data sheets for unit heaters. Include:
 - .1 Product characteristics.
 - .2 Performance criteria.
 - .3 Mounting methods.
 - .4 Physical size.
 - .5 kW rating, voltage, phase.
 - .6 Cabinet material thicknesses.
 - .7 Limitations.
 - .8 Colour and finish.
 - .9 Control.
 - .2 Submit product data sheets for unit heaters.
 - .1 Include product characteristics, performance criteria, physical size, limitations and finish.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for unit heaters for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan and in accordance with Section 01 74 20 –Waste Managing and Disposal.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .5 Collect, package and store existing unit heaters for either reuse, recycling or rebuilding and return to recycler in accordance with Waste Management Plan.

PART 2 PRODUCTS

2.1 WALL MOUNTED CABINET UNIT HEATERS (TYPE B & C)

- .1 Rating: 208 V, 1 phase, refer electrical drawing for wattage.
- .2 Dimensions: 425 mm X 546 mm X 133 mm.
- .3 CSA approved.
- .4 Surface mounted (Type B) in service room and recessed (Type C) in finish area.
- .5 Disconnect switch.
- .6 24 V low voltage relay/transformer kit for 208 V.

.7 Provide mounting accessories as required.

.8 Acceptable Material:

.1 Heatrex

.2 Dimplex

.3 Stelpro

2.2 HORIZONTAL HEATERS (TYPE A)

.1 Rating: Refer to electrical drawings.

.2 24 V low voltage relay/transformer kit for required voltage, refer to electrical drawings.

.3 Ceiling / wall mount.

.4 CSA approved.

.5 Motor & Fan: fan size matched to power output of unit. Motor is heavy duty, continuous operation, totally enclosed, thermally protected with permanently lubricated ball bearings.

.6 Fan Flow: 189 l/s.

.7 Adjustable discharge louvers.

.8 Thermal Overload protection.

.9 Disconnect switch.

.10 Provide mounting accessories as required.

.11 Acceptable Material:

.1 Trane

.2 Dimplex

.3 Heatrex

2.3 CEILING CABINET UNIT HEATERS (TYPE D)

- .1 Rating: 208 V, 3 phase, 3 kW.
- .2 24 V low voltage relay/transformer kit for 208 V.
- .3 Recessed mounted in ceiling.
- .4 Fan Motor: motors are permanently lubricated, unit bearing, totally enclosed shade pole type with impedance protection. Motors are same voltage as the heater.
- .5 Fan flow: 200 l/s.
- .6 Dimensions: 572 mm X 572 mm X 232 mm.
- .7 Thermal overload protection.
- .8 Disconnect switch.
- .9 Provide mounting accessories as required.
- .10 Acceptable Material:
 - .1 Trane
 - .2 Dimplex
 - .3 Stelpro

2.4 RADIANT CEILING PANELS (TYPE E)

- .1 Rating 208 V, 1 phase, refer to electrical drawings for size.
- .2 Alloy resistance wire element, electrically insulated, rated to 250°C, uniformly distributed over panel face.
- .3 24 V low voltage relay/transformer kit for 208 V.
- .4 T-bar Mounted.
- .5 Universal Mounting clips to be used for mounting in T-bar ceiling.
- .6 Minimum 50 mm thick high temperature mineral wool insulation.
- .7 CSA approved

- .8 Casing: 22 gauge galvanized steel.
- .9 Finished colour to suite.
- .10 Thermal overload protection
- .11 Disconnect switch.
- .12 Acceptable Material:
 - .1 Marley
 - .2 Therma-Ray
 - .3 Qmark

2.5 CONTROLS

- .1 Remote electronic thermostat.
- .2 Built-in low voltage relay/transformer kit for remote control.
- .3 Thermostats to be from the same manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Surface mount fan forced wall heaters in service rooms and recessed in finish area (corridor 112).
- .2 Ceiling mount horizontal heaters.
- .3 Recess mount ceiling unit heaters.
- .4 Make power and control connections.
- .5 Install all wiring in conduit.
- .6 Provide vandal resistant wire guard for thermostat in room 201.
- .7 Mount thermostat in location as indicated.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results – For Electrical.
- .2 Test cut-out protection when air movement is obstructed.
- .3 Test fan delay switch to assure dissipation of heat after element shut down.
- .4 Test unit cut-off when fan motor overload protection has operated.
- .5 Ensure heaters and controls operate correctly.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results – For Electrical.
- .2 Section 26 05 31 – Splitters, Junction, Pull Boxes and Cabinets.
- .3 Section 26 05 34 – conduits, Conduit Fastenings and Conduit Fittings.

1.2 CONTENT

- .1 Entrance chime system.
- .2 Panic alarm system.

1.3 REFERENCES

- .1 CSA International

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations for the following systems :
 - .1 Entrance chime system.
 - .2 Panic alarm system.

1.5 SUBMITTALS

- .1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit product data and shop drawings for entrance chime system and panic alarm system components.
- .3 Submit test report for field testing of ground fault equipment to Departmental Representative and a certificate that system as installed meets criteria specified herein.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20 – Waste Managing and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labeled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

- .2 Store and protect from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 ENTRANCE CHIME SYSTEM

- .1 Provide wired door chime system as indicated on drawing to operate as follows:
 - .1 Chime will sound when public entry door push button is pressed and sound with different tone when door 101 is opened.
 - .2 System components include:
 - .1 Chime: wired, minimum four (4) tone, wall mounted, adjustable volume, wood finish.
 - .2 Low voltage Class II transformer: input 120 V, 60 Hz; output 16 VAC, 10 VA; mounted on junction box.
 - .3 Push button: rated for outdoor, illuminated, stainless steel finish.
 - .4 Door contact: wired, surface mount.

2.2 PANIC ALARM SYSTEM

- .1 Provide and install wired panic alarm system is indicated on drawing. System components include:
 - .1 Momentary mushroom type push button: red, push to activate, stainless steel backplate, momentary contact (one N.O. and one N.C. rated 10A at 120 A), cover to be mounted directly onto the push button, custom labelling, CSA or ULC listed.
 - .2 Momentary mushroom type push button: red, push to reset (silence), stainless steel plate, momentary contact (one N.O. and one N.C. rated 10A at 120 A), cover to be mounted directly onto the push button, custom labelling, CSA or ULC listed.
 - .3 Horn: heavy duty, 120 V, electronic, 90 dB at 3 m, adjustable sound, wall mounted, CSA or ULC listed.
 - .4 Cabinet: refer to Section 26 05 31 – Splitters, Junction, Pull Boxes and Cabinets.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Panic alarm horn and chime tone/sound shall be different from fire alarm system sound.
- .2 No wireless devices are acceptable. All system components shall be wired.
- .3 Install all wiring in conduit.
- .4 Coordinate panic alarm push button colour and labelling with Departmental Representative.
- .5 Conceal all conduit.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Test system for operation and sound level.

3.3 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 24 02 - Service Entrance Board.
- .2 Section 26 24 16.01 - Panelboards Breaker Type.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No. 5-13, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2013).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Include time-current characteristic curves for provided breakers.
- .4 Certificates:
 - .1 Prior to installation of circuit breakers in either new or existing installation, Contractor must submit 3 copies of a production certificate of origin from the manufacturer. Production certificate of origin must be duly signed by factory and local manufacturer's representative certifying that circuit breakers come from this manufacturer and are new and meet standards and regulations.
 - .1 Production certificate of origin must be submitted to Departmental Representative for approval.
 - .2 Delay in submitting production of certificate of origin will not justify any extension of contract and additional compensation.
 - .3 Any work of manufacturing, assembly or installation to begin only after acceptance of production certificate of origin by Departmental Representative. Unless complying with this requirement, Departmental

Representative reserves the right to mandate manufacturer listed on circuit breakers to authenticate new circuit breakers under the contract, and to Contractor's expense.

- .4 Production certificate of origin must contain:
 - .1 Manufacturer's name and address and person responsible for authentication. Person responsible must sign and date certificate.
 - .2 Licensed dealer's name and address and person of distributor responsible for Contractor's account.
 - .3 Contractor's name and address and person responsible for project.
 - .4 Local manufacturer's representative name and address. Local manufacturer's representative must sign and date certificate.
 - .5 Name and address of building where circuit breakers will be installed:
 - .1 Project title.
 - .2 End user's reference number.
 - .3 List of circuit breakers.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store circuit breakers off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect circuit breakers from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 20 –Waste Managing and Disposal.

PART 2 PRODUCTS

2.1 BREAKERS GENERAL

- .1 Moulded-case circuit breakers and ground-fault circuit-interrupters to CSA C22.2 No. 5.
- .2 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
- .5 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .6 Circuit breakers with interchangeable trips as indicated.
- .7 Circuit breakers to have minimum symmetrical RMS interrupting capacity rating same as associated board. Series rating for breakers is not acceptable.
- .8 Service entrance rated for main circuit breaker in service entrance board.

2.2 THERMAL MAGNETIC BREAKERS

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 MAGNETIC BREAKERS

- .1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

2.4 MOTOR CIRCUIT PROTECTORS (MCP)

- .1 Moulded case circuit breaker to operate automatically by means of solid state tripping devices to provide instantaneous tripping for short circuit protection.
- .2 MCP tripping range to allow for starting motors direct-on-line. Adjustable range from 700% to 1700% of motor full load amps.

2.5 SOLID STATE TRIP MAIN BREAKERS

- .1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, long time, short time, instantaneous tripping for phase and ground fault short circuit protection. Breaker with adjustable pickup and the delay values.
- .2 Circuit breaker equipped with two sets of auxilliary contacts. One set of contacts shall close on trip to provide trip status. The second set of contacts shall close when the breaker is in the OFF position to provide OFF status.

2.6 OPTIONAL FEATURES

- .1 Include, as indicated on drawings:
 - .1 Shunt trip.
 - .2 Auxiliary switch.
 - .3 On-off locking device.
 - .4 Handle mechanism.

2.7 ENCLOSURE

- .1 Locate and mount in enclosure as indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install circuit breakers as indicated.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 – Waste Managing and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

- .1 CSA International
 - .1 CAN/CSA C22.2 No.144-M91(R2011), Ground Fault Circuit Interrupters.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA PG 2.2-1999(R2009), Application Guide for Ground Fault Protection Devices for Equipment.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for ground fault circuit interrupters and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Test and Evaluation Reports: submit test report for field testing of ground fault equipment to Departmental Representative and certificate that system as installed meets criteria specified.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for ground fault circuit interrupters for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect ground fault circuit interrupters from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 20 - Waste Managing and Disposal.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA C22.2 No.144 NEMA PG 2.2.
- .2 Components comprising ground fault protective system to be of same manufacturer.

2.2 BREAKER TYPE GROUND FAULT INTERRUPTER

- .1 Single or two pole ground fault circuit interrupter for 1 phase circuit c/w test and reset facilities. Rating as indicated on drawings.

2.3 GROUND FAULT PROTECTOR UNIT

- .1 Self-contained with 20 A, 120 V circuit interrupter and duplex U-ground receptacle, CSA Type 5-20R, colour ivory, complete with:
 - .1 Solid state ground sensing device.
 - .2 Facility for testing and reset.
 - .3 Matching cover plate.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for ground fault circuit interrupters installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and co-ordinate with Section 01 45 00 - Quality Control if required.
- .2 Arrange for field testing of ground fault equipment by ground fault equipment manufacturer before commissioning service.
- .3 Demonstrate simulated ground fault tests.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning and Waste Processing.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 - Waste Managing and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA C22.2 No.4-04 (R2009), Enclosed and Dead-Front Switches (Tri-National Standard With ANCE NMX-J-162-2004 and UL 98).
 - .2 CSA C22.2 No.39-13, Fuseholder Assemblies.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20 – Waste Managing and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Separate for reuse and recycling and place in designated containers waste in accordance with Waste Management Plan.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.1 DISCONNECT SWITCHES

- .1 Fusible, non-fusible, horsepower rated disconnect switch in CSA Enclosure Type 3 for indoor application and Type 4 for outdoor application, to CAN/CSA C22.2 No.4, size as indicated.
- .2 Provision for padlocking in OFF switch position by three locks.
- .3 Mechanically interlocked door to prevent opening when handle in ON position.
- .4 Fuses: size as indicated, in accordance with Section 26 28 13.01 - Fuses - Low Voltage.
- .5 Fuseholders: to CSA C22.2 No.39 relocatable and suitable without adaptors, for type and size of fuse indicated.
- .6 Quick-make, quick-break action.
- .7 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

2.3 WARNING SIGNS

- .1 Provide warning signs in accordance with Section 26 05 00 - Common Work Results - For Electrical.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results – For Electrical.
- .2 Section 26 29 03 - Control Devices.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.14-13, Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 2-2000 (R2005), Controllers, Contactors and Overload Relays Rated 600 V.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for contactors and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.

- .2 Operation and Maintenance Data: submit operation and maintenance data for contactors for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect contactors from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 20 –Waste Managing and Disposal.

PART 2 PRODUCTS

2.1 CONTACTORS

- .1 Contactors: to CSA C22.2 No.14.
- .2 Electrically held controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.
- .3 Breaker combination contactor as indicated.
- .4 Complete with 4 normally open and 4 normally closed auxiliary contacts unless indicated otherwise.
- .5 Mount in CSA Enclosure Type 3R unless otherwise indicated.

- .6 Include following options in cover:
 - .1 Red and Green indicating lamp.
 - .2 Stop-Start pushbutton.
 - .3 Hand-Off-Auto selector switch.
- .7 Control transformer: in accordance with Section 26 29 03 - Control Devices, factory wired and installed in contactor enclosure.

2.2 EQUIPMENT IDENTIFICATION

- .1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Size 4 nameplate indicating name of load controlled as indicated.

2.3 WARNING SIGNS

- .1 Provide warning signs in accordance with Section 26 05 00 - Common Work Results - For Electrical.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install contactors and connect power wires and auxiliary control devices.
- .2 Identify contactors with nameplates or labels indicating panel and circuit number.
- .3 Test contactors in accordance with 26 05 00 - Common Work Results for Electrical.

3.2 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 – Waste Managing and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.3 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by contactor installation.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 29 01 - Contactors.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.14-13, Industrial Control Equipment.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA ICS 1-2000(R2008), Industrial Control and Systems: General Requirements.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for control devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Nova Scotia, Canada.
 - .2 Include schematic, wiring, interconnection diagrams.

1.4 QUALITY ASSURANCE

- .1 Conduct tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for control devices for incorporation into manual.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect control devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 20 –Waste Managing and Disposal.

PART 2 PRODUCTS

2.1 AC CONTROL RELAYS

- .1 Control Relays: to CSA C22.2 No.14 and NEMA ICS 1.
- .2 Universal pole type: electrically held with 4 poles, convertible from NO to NC by changing wiring connections. Coil rating: 120 V, 5 VA. Contact rating: 120 V, 5 A.

2.2 RELAY ACCESSORIES

- .1 Standard contact cartridges: normally-open - convertible to normally-closed in field.

2.3 SOLID STATE TIMING RELAYS

- .1 Construction: AC operated electronic timing relay with solid-state timing circuit to operate output contact. Timing circuit and output contact completely encapsulated to protect against vibration, humidity and atmospheric contaminants.
- .2 Operation: on-delay or off-delay.
- .3 Potentiometer: self contained to provide time interval adjustment.
- .4 Supply voltage: 120 V AC, 60 Hz.
- .5 Temperature range: minus 20 degrees C to plus 60 degrees C.
- .6 Output contact rating: maximum voltage 300 V AC or DC. Current: 5 A.
- .7 Timing ranges: as indicated.

2.4 OPERATOR CONTROL STATIONS

- .1 Enclosure: to provide a degree of environmental protection equal to or higher than CSA Type 2 for indoor and 4X for outdoor, surface mounting; unless noted otherwise.

2.5 PUSHBUTTONS

- .1 Heavy duty oil tight. Operator flush type. Black or Green, with 1-NO and 1-NC contacts rated at 120 V, 5 A, AC, labels as indicated. Stop pushbuttons coloured red, labelled "stop".

2.6 VANDAL RESISTANT PUSHBUTTONS

- .1 Vandal resistant, rugged design, protection against vandalism. Heavy duty oil tight. Operator flush type. 1-NO and 1-NC contacts rated at 120 V, 5 A, AC. Labels as indicated. Pushbuttons shall turn motor ON and pressed once to turn motor OFF.
- .2 Mounted in vandal resistant, stainless steel wall plate.
- .3 Refer to Appendix A for approved Tamperproof screws.

2.7 SELECTOR SWITCHES

- .1 Maintained 2 and 3 position labelled as indicated heavy duty oil tight, operators knob, contact arrangement as indicated, rated 120 V, 5 A, AC.

2.8 INDICATING LIGHTS

- .1 Heavy duty oil tight, full voltage, LED type, push-to-test, lens colour: as indicated, supply voltage: 120 VAC, lamp voltage: 120 VAC, labels as indicated.

2.9 CONTROL AND RELAY PANELS

- .1 Panel to provide a degree of environmental protection equal to or higher than CSA Type 2 for indoor and 4X for outdoor, sheet steel enclosure with hinged padlockable access door, accommodating relays, timers, labels as indicated, factory installed and wired to identified terminals.

2.10 CONTROL CIRCUIT TRANSFORMERS

- .1 Single phase, dry type.
- .2 Primary: 600 V or 208 V, 60 Hz, AC.

- .3 Secondary: 120 VAC.
- .4 Rating: 250 VA, unless noted otherwise.
- .5 Secondary fuse: 3 A, unless noted otherwise.
- .6 Close voltage regulation as required by magnet coils and solenoid valves.

2.11 WARNING SIGNS

- .1 Provide warning signs (where applicable) in accordance with Section 26 05 00 - Common Work Results - For Electrical.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for control devices installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install pushbutton stations, control and relay panels, control devices and interconnect as indicated.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at time and check out operation of section.
- .3 Upon completion of sectional test, undertake group testing.
- .4 Check out complete system for operational sequencing.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 – Waste Managing and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 29 01 - Contactors.

1.2 REFERENCES

- .1 NEMA ICS 2, Industrial Control and Systems.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide shop drawings for each type of starter to indicate:
 - .1 Mounting method and dimensions.
 - .2 Starter size and type.
 - .3 Layout and components.
 - .4 Enclosure types.
 - .5 Wiring diagram.
 - .6 Interconnection diagrams.
 - .7 Certifications and approvals.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide maintenance materials in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.
- .3 Extra Materials:
 - .1 Provide listed spare parts for each different size and type of starter.
 - .1 3 contacts, stationary.
 - .2 3 contacts, movable.
 - .3 1 contacts, auxiliary.
 - .4 1 control transformers.
 - .5 1 operating coil.
 - .6 2 fuses.
 - .7 10% indicating lamp bulbs used.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle in accordance with Section 01 61 00 - Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return of packaging materials in accordance with Section 01 74 20 – Waste Managing and Disposal.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Starters: to NEMA ICS 2. Full size starters (half size are not acceptable).

2.2 MANUAL MOTOR STARTERS

- .1 Single phase manual motor starters of size, type and rating as indicated, with components as follows:
 - .1 Switching mechanism, quick make and break.
 - .2 One and two overload heaters, manual reset, trip indicating handle.
 - .3 Enclosure to provide a degree of environmental protection equal to or higher than CSA Type 2 for indoor and 4X for outdoor.
- .2 Accessories:
 - .1 Toggle switch: heavy duty oil tight labelled as indicated.
 - .2 Indicating light: heavy duty oil tight type and colour as indicated.
 - .3 Locking tab to permit padlocking in "ON" or "OFF" position.
- .3 Recess manual starter in finished areas.

2.3 FULL VOLTAGE MAGNETIC STARTERS

- .1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
 - .1 Contactor solenoid operated, rapid action type. Pick-up voltage minimum 75% of nominal, drop-out voltage less than 70% of nominal.
 - .2 Motor overload protective device in each phase, manually reset from outside enclosure.
 - .3 Wiring and schematic diagram inside starter enclosure in visible location.
 - .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.
- .2 Combination type starters to include motor circuit interrupter with operating lever on outside of enclosure to control motor circuit interrupter, and provision for:
 - .1 Locking in "OFF" position with up to 3 padlocks.
 - .2 Independent locking of enclosure door.
 - .3 Provision for preventing switching to "ON" position while enclosure door open.
 - .4 Enclosure to provide a degree of environmental protection equal to or higher than CSA Type 2 for indoor and 4X for outdoor.

.3 Accessories:

- .1 Pushbuttons and selector switches: heavy duty oil tight labelled as indicated.
- .2 Indicating lights: heavy duty oil tight type and color as indicated.
- .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.
- .4 AC current sensor:
 - .1 Ranges:
 - .1 0-5 VDC.
 - .2 LOW: 1 to 10A.
 - .3 MID: 5 to 50A.
 - .4 HIGH: 20 to 200A.
 - .2 Accuracy: +/- 2% of full scale.
 - .3 Repeatability: within +/- 2% of full scale over time, temperature and unit to unit.
 - .4 Loading error: 0.25% error when loaded with 1 megohm (0.025% with 10 megohms, etc.).
 - .5 Frequency: 60 Hz.
 - .6 Operating Temperature: -30°C to +70°C.
 - .7 Case: CYCOLAC (ABS) meets UL flammability rating 94V-O.
 - .8 Response time: 100 ms (10% to 90%).
 - .9 Ripple: Less than 10 mV.

2.4 CONTROL TRANSFORMER

- .1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with primary and secondary fuses, installed in with starter as indicated.
- .2 Size control transformer for control circuit load plus 20% spare capacity.

2.5 ACCESSORIES

- .1 Pushbutton: heavy duty, oil tight as required.
- .2 Selector switches: heavy duty, oil tight as required.

- .3 Indicating lights: heavy duty, oil tight, type and colour as indicated.
- .4 Vandal resistant accessories where indicated.

2.6 FINISHES

- .1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.7 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Manual starter designation label: white plate, black letters, size 1, engraved as indicated.
- .3 Magnetic starter designation label: white plate, black letters, size 1 engraved as indicated.

2.8 WARNING SIGNS

- .1 Provide warning signs (where applicable) in accordance with Section 26 05 00 - Common Work Results - For Electrical.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install starters and control devices in accordance with manufacturer's instructions.
- .2 Install and wire starters and controls as indicated.
- .3 Ensure correct fuses installed.
- .4 Confirm motor nameplate and adjust overload device to suit.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and manufacturer's instructions.
- .2 Operate switches and contactors to verify correct functioning.
- .3 Perform starting and stopping sequences of contactors and relays.
- .4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.3 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .2 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 – Waste Managing and Disposal.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.2 GENERAL

- .1 Work included in this section includes the supply and installation of a containerized standby generator and automatic transfer switch.
 - .1 Install the generator at the location shown and complete all wiring connections.
 - .2 Install the automatic transfer switch in the main electrical room.
- .2 References
 - .1 Reference to technical societies, trade organizations, official standards, governmental agencies, is made in accordance with:
 - .1 NEMA, National Electrical Manufacturers Association.
 - .2 IPCEA, Insulated Power Cable Engineering Association.
 - .3 ISO, International Standards Organization.
 - .4 IEEE, Institute of Electrical and Electronic Engineers.
 - .5 NFPA, National Fire protection Association.
 - .6 ASTM, American Society for Testing and Materials.
 - .7 CSA, Canadian Standards Association:
 - .1 Canadian Electrical Code, Part 1 C22.1-2012.
 - .2 C22.2 No. 100-04(R2009) Motors and Generators.
 - .3 C282-09 Emergency Electrical Power Supply for Buildings.
 - .8 IPCEA, Insulated Power Cable Engineering Association.
 - .9 ISO, International Standard Organization 8528-1:1993 Reciprocating internal combustion engine driven alternating current generating sets - Part 1: Application, ratings and performance.
 - .10 IEEE, Institute of Electrical and Electronic Engineers 519-1992 Recommended Practices and Requirements for Harmonic Control in Electric Power Systems.

- .11 NFPA Standard 37-98 Installation and Use of Stationary Combustion Engines and Gas Turbines.
- .12 ASTM, American Society for Testing and Materials.
- .13 Canadian Centre for Occupational Health and Safety.
- .14 Liquid Fuels Handling Code.
- .15 B-139 Installation Code for Oil-burning Equipment.
- .16 The generator set shall be CSA certified.
- .2 Canadian Centre for Occupational Health and Safety.
- .3 Where reference is made to a specification by one of the above-mentioned or other Association, it is understood that the latest revision thereof shall apply.
- .4 Specifications by these Associations are used only to supplement this specification and shall not in any way reduce the standards established herein.
- .3 Requirements of Regulatory Agencies
 - .1 Comply with the requirements of the current edition of the applicable "rules and regulations" as required by authorities having jurisdiction.
- .4 Shop Drawings
 - .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Shop drawings are required to show the following:
 - .1 Dimensions and physical location of component parts.
 - .2 Dimensions and location of all building openings and cable entrances.
 - .3 Schematic wiring diagrams for building power, lighting, ventilation and control.
 - .4 Weight of entire assembly to be shown on drawing.
 - .5 Structural and architectural drawings of the shelter with the manufacturer name.
- .5 Documents
 - .1 Comply with requirements of Part 1- General Requirements, Part 2 - Products and Part 3 - Inspection and Tests which are all integral part of the Contract Documents.
- .6 Commissioning and Instructions to the User:
 - .1 A representative from the company will be in attendance during the commissioning to verify unit and all ancillary systems installation,

- operation and start-up for warranty record. The system will be tested and calibrated under load condition.
- .2 Instruct the user on site on all aspects of the operation and maintenance of systems, equipment and software. Demonstrate the following system parameters:
 - .1 Normal operation with AC source.
 - .2 Genset start-up in the manual and automatic modes.
 - .3 Operation with emergency source for 4 hours.
 - .4 Automatic re-transfer, cool down and shutdown within specification limits.
 - .5 Alarm, safety shutdown and status indicators.
 - .6 Software installation and operation (if applicable).
 - .3 Submit in writing, to Departmental Representative, within three weeks after Gen Set on site commissioning, the time of final inspection and a complete list stating:
 - .1 Date operating instructions were given to the user's staff.
 - .2 Duration of instruction.
 - .3 Name of persons instructed.
 - .4 Other parties present (manufacturer's representative, consultants, etc.)
 - .5 Signature of the user's staff stating that he properly understood the system operation, basic maintenance requirements and has received the required number of Operating and Maintenance Manuals.
 - .6 Any comments and or recommendations on Genset installation and site condition.
 - .7 Fabrication and Manufacture
 - .1 Fabricate and manufacture products supplied from new materials, free of defects, complying with the applicable "Codes" and specified "Standards", in accordance with Contract Documents.
 - .8 Product Identification
 - .1 Products required to have CSA, CUL or other approvals shall be properly marked or labelled indicating that the product has been approved.
 - .9 Final Acceptance
 - .1 Final acceptance shall be made after on site installation and when all defects have been corrected and signed by both parties.

.10 Warranty

- .1 Provide a written guarantee, stating the Generator Set system is guaranteed against any defects of material and workmanship for a period of 1 (one) year from the date of on site commissioning, or manufacturer's standard warranty period, whichever is longer. A representative from the company will be in attendance during the commissioning to verify unit installation, operation and start-up for warranty record. The system will be tested and calibrated under load condition.

.11 Operation and Maintenance Manuals

- .1 Provide three (3) manuals, complete with installation, operation, maintenance instruction and field technician service trouble shooting guide for the Generator Set being supplied under this contract. The complete manual set shall contain a bill of material which shall include an itemized list of all individual components, with drawing code, quantity, part numbers, description, manufacturer, supplier and all electrical schematic drawings.
- .2 Provide all the electrical schematic drawings of the power system and control system and drawings showing the installation connections for both control and power.
- .3 Provide a component location drawing which shows the relative physical location of the electrical components of the control panel such as relays, transformers, breakers, terminal strips, etc.
- .4 The description of operation of the controls shall describe the entire sequence of all components, for all conditions, indicating the path the current will take during these conditions and referring to specific contacts and specific relay and timer controls.
- .5 Manuals shall contain operational maintenance and parts information covering all components used.
- .6 Include instructions for operation, a guide to trouble shooting, an itemized list showing the recommended frequency of service of the various components, and a table showing the recommended settings of all time delay relays and other adjustable devices.
- .7 Maintenance and operating instructions to include the following:
 - .1 Description of equipment.
 - .2 Shop drawings of equipment.
 - .3 Operation of equipment.
 - .4 Schematic diagrams of all printed circuit cards, board component lay out and all other repairable assemblies comprising the systems delivered.
 - .5 Diagrams of systems.
 - .6 Maintenance of equipment.

- .7 Servicing of equipment including component replacement.
- .8 Field technician service trouble-shooting guide.
- .9 List of recommended test equipment including parameters to be measured.
- .10 Spare parts list.
- .11 Names and addresses of spare parts suppliers.
- .12 Test reports.
- .13 Certificates of Compliance.
- .14 Include warranty certificate as detailed in Part 1.
- .8 Technical data and description of items shall be in the form of approved bulletins. Advertising or sales literature is not acceptable.
- .9 The manuals shall, be enclosed in vinyl covered hard binding and shall be three (3) ring loose leaf with 215 x 280 mm size paper. The contents shall be segregated into sections separated by plastic protected identifying tabs. Drawings larger than the binder are to be folded and secured in paper envelopes which are to be secured by the three (3) rings.
- .10 Submit one (1) copy of the complete operation and maintenance manual, of the Generator model supplied, for review and approval to the Departmental Representative, three (3) weeks before factory acceptance.
- .12 Spare Parts
 - .1 Include a list of recommended spare parts, tools and instruments with catalogue numbers.

1.3 SCOPE OF WORK

- .1 The Generator Set shall consist of a diesel engine prime mover, cooling system, AC alternator, starting battery(s) and charger, microprocessor system control, protective devices silencer, housing, sub-base fuel tank, and accessories as specified herein that shall automatically start and provide continuity of electric power within specified tolerances upon failure or deterioration of the normal AC power source. Upon restoration of the normal AC power source the diesel generator shall automatically transfer back, cool and shutdown the diesel generator.
- .2 Supply and install generator set in a weatherproof enclosure capable of stand-alone operation.
- .3 The steel shelter assembly shall meet or surpass every applicable Canadian code for this type of enclosure, installation and these specifications.

- .4 The contractor shall include in each APU O&M manual all the structural, architectural, mechanical and electrical shelter drawings.

PART 2 PRODUCTS

2.1 GENERATOR SET

- .1 The generator set shall be rated 600/347 V, 3 phase, 4 wire.
 - .1 Voltage regulation shall be plus or minus 0.5% for any constant load between no load and rated load. Random voltage variation with any steady I load from no load to full load shall not exceed plus or minus 0.5 percent.
 - .2 Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25%.
 - .3 The diesel engine generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable de-rating factors, with the engine generator set at operating temperature.
 - .4 The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic.
 - .5 The engine generator set shall be mounted on a heavy-duty steel base to maintain alignment between components.
 - .6 Provide vibration isolators of the spring/pad type, quantity as recommended by the generator set manufacturer.
- .2 Diesel Engine (Prime Mover)
 - .1 The engine shall be a turbo charged liquid-cooled four (4) stroke diesel of heavy duty design, cold start capable, of current design and in commercial use for electrical power generation. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. The engine shall be rated for continuous duty, experimental models will not be considered.
 - .2 The engine shall have removable cylinder liners of the wet or dry type, cylinder heads shall have removable valve seat inserts and guides.
 - .3 An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating and temperature conditions. The control system shall actively control the fuel rate and excitation as

appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous states.

- .4 The fuel system shall be of the direct injection type and automatic engine shutdown shall be independent of the engine governor; the fuel rack shall be energized to run. The fuel system shall have a primary water separator and secondary filtration.
- .5 Full flow lubrication oil filters with replaceable spin on canister elements and dipstick oil level indicator. Provide drain valve for draining engine oil. The engine shall be capable of operating under all conditions when using engine lube oil, grade as recommended by manufacturer, MIL spec L-2104D.
- .6 The engine shall be equipped with one or more heavy duty dry type air cleaner(s) with restriction indicator.
- .7 The engine cooling system shall be thermostatically controlled and shall be sized to maintain engine coolant at the recommended temperature when operating the engine at full load plus 10% in ambient temperature of 50° C. Fan assembly shall be enclosed with a suitable guard and filler cap shall be designed for pressure relief prior to removal.
- .8 Radiator shall be Unit Mounted, engine shall be supplied with a direct skid mounted radiator and fan driven off engine crankshaft. Radiator shall be provided with a duct adapter flange.
- .9 The cooling system shall be thermostatically controlled, engines supplied with inhibited ethylene glycol anti-freeze (-50° C), supplied in engine.
- .10 All non-metallic cooling system hoses shall be of the reinforced silicon rubber type with proper end fittings to form a positive connection.
- .11 Provide drain valves for draining engine block, and radiator coolant.
- .12 Engine mounted circulating type coolant heater(s), thermostatically controlled. Heater voltage shall be 208 V. The coolant heater shall be CSA certified.
- .13 The coolant heater shall be installed on the engine with silicone hose connections. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heater(s) shall be installed using quick disconnect couplers to isolate the heater for replacement of the heater element. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.
- .14 The coolant heater shall be provided with a thermostat, installed at the engine thermostat housing and interconnected with the engine start run circuit to shut the heater off during engine operation. An AC power connection box shall be provided for a single AC power connection to the coolant heater system.
- .15 The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 40° C.

- .16 The engine shall have a battery charging alternator, 12 or 24 Volt DC starting system complete with heavy-duty battery(s) capable of minimum of three successive start attempts. Batteries to be mounted in an internal skid type battery rack or externally mounted steel frame. Battery cables are to be supplied and provide for not more than 5% voltage drop at peak load, cables are to have protective post connection covers to prevent accidental contact with live terminals.
 - .17 Supplied with the engine shall be a hospital grade exhaust muffler providing sound attenuation of 77 dB measured at 7 m at full load. Also included will be a flexible stainless section to absorb engine vibration complete with flanges/couplings to fit to engine. Unit shall be EPA certified.
- .3 AC Generator
- .1 The AC generator shall be synchronous, revolving field, drip-proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 105° C.
 - .2 The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor at any voltage not more than 5% above or below rated voltage.
 - .3 A permanent magnet generator (PMG) shall be included to provide excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three-phase fault at approximately 300% of rated current for not more than 10 seconds.
- .4 Generator Set Controls (Microprocessor)
- .1 The generator set shall be provided with a microprocessor-based control system designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local and remote monitoring and control of the generator set.
 - .2 The control shall be mounted on the generator set and be vibration isolated. The control system enclosure shall be oil tight and dust tight, and the enclosure door shall be gasketed.
 - .3 The generator set control shall include a System Control Switch with the following functions:
 - .1 MANUAL - the generator set shall start and accelerate to rated speed and voltage.
 - .2 STOP - the generator will immediately stop, bypassing all time delays.
 - .3 AUTO - the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.

- .4 RESET - the switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
- .5 An EMERGENCY STOP switch - Red "mushroom head" push button shall be installed. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting. Provision for a remotely connected Emergency Stop switch shall be provided.
- .6 PANEL LAMP switch - depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power.
- .4 AC Output Metering - The generator set shall be equipped with a metering to provide the functions:
 - .1 Analog or digital voltmeter, ammeter, frequency meter, and kilowatt (kW) meter. Voltmeter and ammeter shall display all three phases. Generator output voltage meter to display line to line and line to neutral. Metering accuracy to be within 0.5%.
 - .2 The analog or digital metering equipment shall be driven by the single microprocessor, to provide consistent readings and performance.
- .5 Generator Set Alarm and Status Display shall indicate the existence of the following alarm and shutdown conditions on a digital display panel and provide indicating lamps of the high intensity LED type to indicate the following conditions:
 - .1 Unit not in automatic mode.
 - .2 Low oil pressure (alarm).
 - .3 Low oil pressure (shutdown).
 - .4 Low coolant temperature (alarm).
 - .5 High coolant temperature (alarm).
 - .6 High coolant temperature (shutdown).
 - .7 Low coolant level (alarm or shutdown - selectable).
 - .8 Fail to start/over-crank (shutdown).
 - .9 Over-speed (shutdown).
 - .10 Low DC voltage (alarm).
 - .11 High DC voltage (alarm).
 - .12 Low fuel level (alarm).
 - .13 High AC voltage (shutdown).
 - .14 Low AC voltage (shutdown).
 - .15 Under frequency (shutdown).
 - .16 Over current (warning).

- .17 Over current (shutdown).
- .18 Short circuit (shutdown).
- .19 Over load (alarm).
- .20 Emergency stop (shutdown).
- .21 Low fuel (shutdown).
- .6 Provisions shall be made for indication of four customer specified alarms or shutdown conditions. The non automatic indicating lamp shall be red, and shall flash to indicate that the generator set is will not respond to a start from transfer switch.
- .7 Engine Status Monitoring shall be available from the digital status panel on the generator set control to provide the following functions:
 - .1 Engine oil pressure (psi or kPA).
 - .2 Engine coolant temperature (degrees F or C).
 - .3 Engine oil temperature (degrees F or C).
 - .4 Engine speed (rpm).
 - .5 Total operating hours.
 - .6 Battery voltage (DC volts).
- .8 Engine Control Functions shall include a cycle cranking system, which allows for user selected crank time, rest time, and number of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.
- .9 The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.
- .10 The control system shall include an engine governor control to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.
- .11 The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
- .12 Alternator Control Functions shall include an automatic digital voltage regulation system that is matched with the governing system provided. The voltage regulation system shall be equipped with three phase RMS sensing and shall control build-up of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of 59 Hz. The voltage regulator shall include adjustments for gain, and damping. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED readout to indicate setting level.

- .13 Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown).
 - .14 Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown).
 - .15 Controls shall be provided to monitor the kW load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds.
 - .16 An AC over/under voltage monitoring system that shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.
 - .17 A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25 VDC or more than 32 VDC. During engine cranking (starter engaged), the low voltage limit shall be disabled, and if DC voltage drops to less than 14.4 Volts for more than two seconds a low battery alarm shall be initiated.
 - .18 A remote alarm annunciator with horn shall be provided. The remote annunciator shall provide all the audible and visual alarms called for by NFPA Standard 110 for level 1 systems and in addition shall provide indications for high battery voltage, low battery voltage. Alarm silence and lamp test switch shall be provided.
- .5 Main Circuit Breaker
- .1 The generator set shall be equipped with a unit mounted main line circuit breaker sized to carry the rated output current of the generator set on a continuous basis. The circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all over-current conditions, or a thermal-magnetic trip with other over-current protection devices that positively protect the alternator under over-current conditions.
 - .2 The circuit breaker shall also be equipped with a shunt trip device interconnected with the microprocessor to trip the breaker open in the event of an engine/alternator fault shutdown.
 - .3 The circuit breaker shall be mounted within a CSA type 1 enclosure.

.6 Battery Charger and Battery

- .1 A wall mount battery charger shall be provided with the generator set for the starting battery (s). The battery charger shall be a float type charger rated 10 Amps.
- .2 The battery charger shall include an ammeter for display of charging current and shall have fused AC inputs and DC outputs. The charger shall also include fault indications for high and low dc voltage, and supply power failed, and dry contacts for external indication of these fault conditions.
- .3 Starting battery(s) as required for 12 or 24 Volt application shall be supplied with the generator set. Battery shall have sufficient capacity to provide a total 45 seconds cranking capacity at 0° C. Size battery on recommended engine and battery manufactures published data. Provide a heavy-duty polyethylene enclosure with cover to house the starting battery.

.7 Equipment Details

- .1 All material and parts comprising the Generator Set shall be new, of current manufacture, of a high grade and free from all defects and imperfections and shall not have been in prior service, except as required during testing.
- .2 All active electronic devices shall be solid state. All semiconductor devices shall be hermetically sealed. All relays shall be dust tight.
- .3 The maximum working voltage, current and di/dt of all solid state power components and electronic devices shall not exceed 75% of the ratings established by their supplier.

.8 Wiring

- .1 Wiring practices, grounding and material shall be in accordance with the requirements of the applicable codes and standards.
- .2 All bolted connections of bus bar, lugs and cables shall be in accordance with the requirements of the Canadian Electrical Code C22.1-2012, Part 1 and other applicable standards.
- .3 All bus bars and cables shall be high conductivity copper.
- .4 Provision shall be made for power cables to enter and leave from the top or bottom of the Generator Set Breaker/Transfer Switch main connection lugs.

.9 Enclosure

- .1 The enclosure shall be a free standing unit constructed on a common base, formed from 254 mm Structural Channel sills which shall be equipped with lifting openings.
- .2 The entire enclosure shall be of structural steel frame.
- .3 Clevises shall be installed at intervals around the base for holding down the enclosure during shipment. Sufficient clevises shall be installed to distribute the load so as to prevent any clevis from being pulled out.
- .4 Wall panel joints and standing seam roof section to prevent penetration of rain or snow into the enclosure without application of gaskets.
- .5 The shelter shall have floors of 3 mm steel checker plate over 19 mm weatherproof plywood. The checker plate is to be turned up 76 mm all around the edge to contain any fluid leaks within the container. All seams and corners are to be welded closed. The floor shall be suitably braced within the base assembly to support the equipment and provide a solid spring-free walking surface.
- .6 The entire shelter, walls, ceiling and floor shall be thermally insulated for value of R-20 with form in-place polyurethane insulating/air barrier foam system, Class 1 type. All closed cavities shall be filled with foamed-in-place thermal insulation.
- .7 Internal to the wall shall be structural members providing a continuous horizontal hard point around the interior walls for the securing of equipment. These members shall be positioned, starting at the finished floor and repeating every 609 mm to the ceiling. Each member shall be capable of withstanding, anywhere along it's length a 90 kg. horizontal load.
- .8 The interior exposed surface of the insulation walls and ceiling shall be covered with weatherproof grade 13 mm plywood and an additional cover of white #18 gauge aluminum or steel sheeting secured with removable fasteners. The intersection between adjacent walls, walls and ceiling shall be finished by overlapping of sheets or other means that ensures continuity of interior cladding.
- .9 Exterior walls cladding shall be 22 gauge (minimum) galvanized or steel, pre-painted stone grey.
- .10 The exterior roof shall be interlocking standing seam panels of 22 gauge galvanized or steel, pre-painted as the exterior walls. Penetration of the roof is not permitted.
- .11 All exterior cladding shall be formed to provide a standing seam configuration. The seams shall incorporate a sealant and mechanical crimping element to provide a watertight system when used in zero pitch applications.
- .12 Roof overhangs shall be minimized so as not to interfere with lifting and placing of the unit by crane.

- .13 The enclosure longitudinal steel members shall be positioned such that the generator sets weight is supported directly by the members. The longitudinal members shall be sized to provide adequate support for the generator set, associated equipment and the enclosure during both transportation and operation. Springing or bounce of the enclosure floor as a direct result of equipment operation is not permissible.
 - .14 The engine room doors shall incorporate a pressed steel frame with a thermal break and hollow black neoprene rubber weather stripping (as per included drawings). The door shall be fitted with heavy-duty tamperproof hinges, and panic hardware together with lockable handle. Include also a heavy-duty holdback door retainer to maintain the door in an open position. Provision shall be made for the removal and replacement of the diesel generator, either through the main door, or by incorporating a hinged panel with the main door if necessary. The main door shall be located at the end of shelter.
 - .15 All engine room exterior openings shall be fitted with satisfactory bird screens, 90 degree weather hoods, and shall be completely weather tight when closed.
 - .16 The enclosure shall be large enough to allow field maintenance around the diesel generator and the switchgear. Walkway shall be at least 1000 mm in width.
 - .17 The underside of the building and the skid base shall be protected against corrosion with an application of Rust Control compound.
 - .18 The preceding subparagraphs are intended to indicate a minimum standard of construction. The responsibility for proper structural design shall rest with the contractor.
 - .19 The enclosure should contain a heater in order to maintain 10 degrees Celsius as required by CSA-C282.
- .10 Electrical System
- .1 Provide for load cables to enter and leave the shelter on the exterior next to the breaker. Provide also for the fire alarm and remote monitoring conductors leaving the shelter.
 - .2 The cable entrances shall be weather tight boxes with bottom entry, removable for shipping if necessary. The incoming service disconnect shall include a 3 pole breaker of suitable size.
 - .3 Each set of terminals which are to be connected to outgoing conductors are to be clearly identified with lamoid plates bearing the legend eg. Fire Alarm Circuit, Connect to External Control Wiring, or Connect to Normal Power Source, or Connect to Load.
 - .4 Provide a copper ground bus of 25 mm by 3.17 mm. The bus shall be solidly installed at approximately 300 mm above the floor and shall be extended around the inside of the shelter, with a break in the loop, at the door. The neutral of the transformer shall be bonded to the bus, together with all other items requiring grounding as specified in the Canadian

Electrical Code C22.1-2012, Part 1, including the diesel generator frame and the enclosure chassis. Generator shall have a "floating neutral" and generator frame shall be bonded.

- .5 All surface wiring within the container shall be XLPE, 90° Celsius in EMT shall be secured and positioned to be aesthetically pleasing and meet all the requirements of Canadian Electrical Code C22.1-2012, Part 1.
- .6 Conduits or teck cables requiring back support braces or spacing, shall use unistrut type braces. All conduits originated from the generator set shall depart the set from the alternator side or top to the switchboard panel.
- .7 All container exterior wiring shall be XLPE, 90° Celsius in liquid tight rigid conduit only.
- .8 A surface mounted panel board shall be provided for container internal circuits and which shall be 208/120 V, 100 A, 3 phase, 4 wire, with main breaker, copper bus, and bolt-on breakers to feed the following required container items:
 - .1 A electric heating system with integral fan shall be installed to maintain an inside temperature of 10° C. This system shall be thermostatically operated, and shall not operate when the cooling exhaust fan is in operation. The heater warm airflow shall not be directed towards any thermostat. The heaters shall have thermal cut-outs for element and fan, and permanently lubricated bearings.
 - .2 Container compartment lighting system shall consist of the required industrial fluorescent lights with mechanical guards, equipped with -20° Celsius ballast, to achieve a minimum level of 500 Lux through the entire compartment. The lighting control switch shall be on the wall inside the entry door.
 - .3 At least four AC receptacle outlets shall be provided; the outlets shall be best located to service the equipment.
 - .4 Diesel engine block heater(s).
 - .5 Alternator anti-condensation heater.
 - .6 Battery Charger for starting batteries.
 - .7 Emergency lighting.
 - .8 Ventilation system.
 - .9 OPS area.
- .9 Each receptacle shall be on a dedicated 120 V circuit.
- .10 An emergency lighting system, battery operated, automatically charged, manual operation, shall be supplied to provide emergency light if both utility and emergency power fail. Operation of light system shall be by means of a manual switch mounted on wall inside entry door. The unit shall utilize a sealed long life lead acid battery and shall be mounted to

spread light on the transfer switch panel and generator set. The minimum operating time shall be 60 minutes.

- .11 An emergency, weatherproof, shutdown switch shall be installed on the exterior of shelter, close to the lock side of the main entry door. The switch shall be wired and connected to the engine control circuit so that opening of the switch contracts will immediately shutdown the engine. The switch is to have maintained contacts, requiring manual reset to revert to normal conditions. The switch shall be plainly marked "Diesel Emergency Stop". It shall be mounted in a "break glass enclosure".

.11 Automatic Engine Room Ventilation System

- .1 A complete ventilation system shall be supplied to operate the generator set, it shall include the following equipment:
 - .1 Inlet and exhaust air dampers to be thermostatically controlled and insulated to prevent ingress of driving snow and rain.
 - .2 Intake and exhaust air dampers to provide adequate air for engine combustion and cooling air requirements as per manufactures recommendations.
 - .3 Exhaust dampers to have a parallel set of dampers to recirculate air within enclosure to maintain enclosure temperature during cold weather operation.
 - .4 Intake air damper to be interconnected with engine run circuit and have a minimum open (adjustable pot) setting to provide engine combustion air during initial engine running.
 - .5 Thermostatically controlled, electrically driven cooling exhaust fan with spring return motor damper assembly, sized to limit the average room air temperature to 10° Celsius above the outdoor temperature or 20° Celsius whichever is higher.
- .2 Provide exterior intake and exhaust weather hoods with galvanized 13 mm mesh 16-gauge bird screen and flashing. The final installation of weather hoods shall be on site by installer using silicone sealant to seal all cracks and fissures. Hoods to be painted Stone Grey to match container.
- .3 Install and connect the electrical wiring to the motors, transformers and thermostat.

.12 Fire Alarm & Detection System

- .1 The horn/strobe shall be weatherproof, surface mounted, and a minimum 102 dB. It shall be installed on the exterior of the shelter over the entrance door.
- .2 The unit shall have a silencing button provided to acknowledge alarm, and silence the horn.
- .3 Provide a manual pull station suitable for exterior use.

- .4 Provide one portable 9 kg, CO₂, fire extinguisher and secure adjacent to the entrance door.
- .5 All devices above to be connected to Building Fire Alarm System.

.13 Fuel System

- .1 The shelter/generator set shall include a complete sub-base fuel system with all principal components installed for stand-alone operation. Tank capacity to provide for minimum 48-hour operation at full load. Provide full for testing and leave tank full after on site testing and commissioning.
- .2 Fuel Storage tank:
 - .1 Primary tank shall be ULC approved and supplied with openings for tank fill, vent, liquid level gauge, suction line and fuel return line.
 - .2 Primary tank shall be constructed using steel of welding quality carbon or low alloy steel with medium strength yield of 200 MPa. Thickness of tank body and heads will be 2.5 mm minimum.
 - .3 Tank shall have a liquid level gauge showing levels of empty, 1/4, 1/2, 3/4, and full.
 - .4 Fuel Tank will be installed within the generator enclosure with fill and vent lines piped to enclosure exterior complete with a 53 mm lockable fill cap, 53 mm weatherproof vent cap (ULC approved), 53 mm overfill alarm signal (whistle).
 - .5 Black iron fuel supply and return lines from tank to engine complete with flexible transition lines at the engine.
- .3 Fuel supply line to the engine shall be equipped with a fusible link fire valve and fuel filter/water separator as follows:
 - .1 Spin on type replacement type filter cartridge (2 micron final filtering).
 - .2 Reusable see through bowl with drain.
 - .3 Integral primer pump.
 - .4 Isolating valves of the ball type to be installed on the fuel supply line and filter for maintenance purposes.
 - .5 Low fuel level sensor to be installed in the fuel tank and connected to the microprocessor engine control.
 - .6 Label all pipes and use weatherproof label on pipes that extend outside the container.
- .4 Spill containment box
 - .1 5 gallon minimum capacity, 12 GA mild steel lid and base, lockable weather deflecting non-sparking lid. The finish shall be epoxy painting on the outside and shall match the generator enclosure. A push style drain and retrofit coupler shall be included.

.14 Exhaust System

- .1 Provide a complete exhaust system including the following principal equipment, plus all additional fittings and accessories necessary to form a complete and satisfactory system.
- .2 Install a critical rated exhaust silencer, exhaust pipe, and steel flexible exhaust section, connected to engine exhaust manifold. Support exhaust system to insure that the weight of this assembly is not borne by the engine.
- .3 Install horizontal exhaust piping at a slight angle to the horizontal so as to slope away from the engine to prevent condensation from draining into the engine. Provide drain plug for draining condensation. The exterior exhaust outlet shall be equipped with a suitable hinged rain cap.
- .4 Maintain a separation of 230 mm or more from combustible materials.
- .5 The complete interior exhaust (including exhaust manifolds and turbocharger) shall be thermally insulated with removable high temperature insulating blankets.

.15 Finish

- .1 All exterior attaching hardware shall be stainless steel or hot dip galvanized.
- .2 All soffits, facial and other trim shall be of the same material and colour as the exterior cladding.
- .3 The interior steel checker plated floor shall be primed and painted with a medium grey floor enamel.
- .4 The general layout of the entire shelter shall be as per the included drawings and approved shop drawings.

.16 Assembly

- .1 The steel shelter, diesel generator and switchgear are to be completely assembled and mechanically/ electrically coordinated in the factory in preparation for delivery to the site.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Locate generating unit and install as indicated and to manufacturer's recommendations.
- .2 Install and connect diesel generator cooling system, starting system and controls.
- .3 Install lubrication, cooling fluids and filters.
- .4 Complete wiring and interconnections as indicated and to manufacturer's recommendations.
- .5 Start generating set and test to ensure correct performance of components.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - For Electrical.
- .2 Notify Departmental Representative ten (10) working days in advance of site test date.
- .3 Supply and install temporary cables to connect dummy load bank for testing.
- .4 Provide fuel for testing and leave full tanks on acceptance.
- .5 Demonstrate:
 - .1 Unit start, transfer to load, retransfer to normal power, unit shut down, on "Automatic" control.
 - .2 Unit start and shut down on "Manual" control.
 - .3 Unit start and transfer on "Test" control.
 - .4 Unit start on "Engine start" control.
 - .5 Operation of automatic alarms and shut down devices.
- .6 Run unit on 100% dummy load bank for minimum period of 6 hours to show load carrying ability, stability of voltage and frequency, and satisfactory performance of dampers in ventilating system to provide adequate engine cooling. Record

meter reading at 30 minute intervals. Demonstrate block load tests of 50 and 100%. Use test verification data sheets.

- .7 Record vibration levels of diesel engine and generator.
- .8 At the end of the 6 hour test demonstrate the load acceptance and rejection performance of the system.
- .9 At end of the test, check battery voltage to demonstrate battery charger has returned battery to fully charged state.
- .10 Protection and Control demonstration: verify correct operation of:
 - .1 Coolant overheat protection.
 - .2 Low oil pressure protection.
 - .3 Overcrank protection.
 - .4 Low engine temperature.
 - .5 Low battery power level.
 - .6 All control functions.
- .11 Submit all test results immediately to the Departmental Representative for approval. All deficiencies shall be corrected before the Departmental Representative will provide approval of test results.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00 – Common Work Results – For Electrical.
- .2 Section 26 05 32 Splitters, Junction, Pull Boxes and Cabinets.
- .3 Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings.
- .4 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.
- .5 Division 03 – Concrete.

1.2 SUMMARY

- .1 Heating cable and control devices for the following systems: snow melting systems, de-icing systems and electrical radiant heating systems.
- .2 This Contractor is responsible for:
 - .1 All related calculations.
 - .2 Specifying required materials, equipment and quantities.
- .3 The following information shall be submitted with shop drawings: Calculations, floor plan layouts, cables spacing, cable installation depth, wattage, maximum density and installation details and accessories.
- .4 All equipment from the same manufacturer.
- .5 All system components shall be CSA certified.

1.3 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

- .2 CSA Group
 - .1 CAN/CSA-C22.2 No. 130-03(R2013), Requirements for Electrical Resistance Heating Cables and Heating Device Sets.
- .3 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-12, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for all equipment devices and heating cables and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Refer to 1.2.3 for additional submittal requirements.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for all equipment devices and heating cables for incorporation into manual.
- .3 Record on drawings, layout of snow melting cables electric radiant heating cables and de-icing cable in poured concrete hot mastic asphalt free air. Indicate depth of cable where applicable.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground, indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect heating electrical cables from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 GENERAL

- .1 Heating cables: to CAN/CSA-C22.2 No.130.

2.2 TYPE "A" SELF-REGULATING HEATING CABLE

- .1 To be used for main entrance de-icing system and roof drain de-icing system:
 - .1 Heating cable with a fluoropolymer protective outer jacket. Continuous core conductive polymer extruded between two copper conductors.
 - .2 Cable to vary its power (heat) output all along its length relative to the temperature of the roof surface or the roof drain designed to be crossed over itself without overheating.
 - .3 Self limiting type cable.
 - .4 208 V Cable without the use of transformers.
 - .5 The heating cable power output shall be 43 W/m at 0° degree in ice or snow.
 - .6 The outer jacket of the heating cable shall include the following information: Heating cable model number, CSA listings, meter mark, Lot/Batch ID.
 - .7 Cable shall be factory terminated and assembled, including and not limited: Cold lead, NPT threaded connector and connection kit.
 - .8 Required cable length shall be cut in the factory and not in the field.

2.3 TYPE "C" SELF-REGULATING HEATING CABLES

- .1 Self-regulating heating cable embedded in concrete for room 209 and 210 electric radiant heating systems.
- .2 Mineral insulated heating cable magnesium oxide insulation and copper sheath.
- .3 Cable to vary its power (heat) output all along its length relative to the temperature of the concrete designed to be crossed over itself without overheating.
- .4 208 V Cable without the use of transformers.
- .5 The heating capacity as shown on drawing.
- .6 The outer jacket of the heating cable shall include the following information: Heating cable model number, CSA listings, meter mark, Lot/Batch ID.
- .7 Cable shall be factory terminated and assembled, including and not limited: Cold lead, NPT threaded connector and connection kit.
- .8 Required cable length shall be cut in the factory and not in the field.

2.4 TYPE "B" SELF-REGULATING HEATING CABLE

- .1 Self-regulating heating cable embedded in concrete for overhead door snow melting system.
- .2 The heating cable shall consist of a continuous core of conductive polymer that is radiation cross-linked, extruded between two (2) 14 AWG nickel-plated copper bus wires that varies its power output in response to temperature changes.
- .3 Cable to vary its power (heat) output all along its length relative to the temperature of the concrete designed to be crossed over itself without overheating.
- .4 Self limiting type cable.
- .5 208 V Cable without the use of transformers.
- .6 The heating cable power output shall be 98 W/m at 0° Degree in ice or snow.
- .7 The outer jacket of the heating cable shall include the following information: Heating cable model number, CSA listings, meter mark, Lot/Batch ID.

- .8 Cable shall be factory terminated and assembled, including and not limited: Cold lead, NPT threaded connector and connection kit.
- .9 Required cable length shall be cut in the factory and not in the field.

2.5 TYPE "D" SELF-REGULATING HEATING CABLE

- .1 Self-regulating heating cable embedded in concrete for 103, 203, 204, 206, 208, 211 and 213 electric radiant heating systems.
- .2 Mineral insulated heating cable magnesium oxide insulation and copper sheath.
- .3 Cable to vary its power (heat) output all along its length relative to the temperature of the concrete designed to be crossed over itself without overheating.
- .4 Self limiting type cable.
- .5 208 V Cable without the use of transformers.
- .6 The heating capacity as shown on drawing.
- .7 The outer jacket of the heating cable shall include the following information: Heating cable model number, CSA listings, meter mark, Lot/Batch ID.
- .8 Connection Kits.
- .9 Cable shall be factory terminated and assembled, including and not limited: Cold lead, NPT threaded connector and connection kit.
- .10 Required cable length shall be cut in the factory and not in the field.

2.6 ACCESSORIES

- .1 Stainless steel prepunched strapping to hold cables in place when embedded in concrete or asphalt fasten to the top of structure steel matt.
- .2 Roof clips to hold cables in place when installed on roof, gutter, drain, pipe. Coordinate installation with roof installer.
- .3 Cable accessories used to attach heating cable onto roof, gutter, drain, pipe, top of structure steel matt and connection components used to terminate heating cable, including power connectors, and end connectors shall be above insulation

type, approved for the application and for the use with the particular type of heating cable. Enclosure rating CSA type 4X.

- .4 Vandal-proof stainless steel box (surface/recessed) and screw where indicated. Refer to Appendix A for approved Tamperproof screws requirements.

2.7 MAIN ENTRANCE DE-ICING SENSOR

- .1 Snow sensing controls consisting of control unit and sensor module. Sensor able to detect: precipitation, blowing snow at ambient temperature at below 3.3°C. Used for main entrance de-icing system.
- .2 Snow falling on heated sensor module to melt, allowing sufficient current to close magnetic relay and complete circuit to control unit output lines, energizing cable installation.
- .3 Operating temperature -40°C to 71°C.
- .4 Compatible with provided controller.
- .5 24 VAC, class 2 circuit.
- .6 Cable lead length up to 609 m.
- .7 Provide sensor with cable length as required.

2.8 ROOF DRAIN DE-ICING SENSOR

- .1 Snow sensing controls consisting of control unit and sensor module. Sensor able to detect: precipitation, blowing snow at ambient temperature at below 3.3°C. Used for roof drain de-icing system.
- .2 Operating temperature -40°C to 71°C.
- .3 Compatible with provided controller.
- .4 24 VAC, class 2 circuit.
- .5 Cable lead length up to 609 m.
- .6 Provide sensor with cable length as required to allow sensor to be mounted in roof drain pipe.

2.9 PAVEMENT SENSOR

- .1 Snow sensing controls consisting of control unit and sensor module. Mounted embedded in pavement (flush mount) and able to detect: pavement temperature, snow and ice condition. Used for overhead door de-icing system.
- .2 Operating temperature -40°C to 71°C.
- .3 Compatible with provided controller.
- .4 24 VAC, class 2 circuit.
- .5 Cable lead length up to 609 m.
- .6 Provide sensor with cable length as required.

2.10 SNOW MELTING CAUTION SIGN

- .1 Rated for outdoor application.
- .2 Embedded in pavement.
- .3 Dimension 150 mm x 100 mm.

2.11 AMBIENT SENSING THERMOSTAT

- .1 Ambient electronic thermostat to control heating cable for floor radiant electrical heat application.
- .2 Adjustable temperature range -1°C to 43°C.
- .3 Wall mounted and rated Nema 4X.
- .4 Supply voltage 208 V, 1-ph and 24 A maximum current.
- .5 LED indication for: power available, heating cable on, sensor failure.
- .6 Sensor shall have: 20 AWG stranded lead, stainless steel sheath, length as required.
- .7 Built-in GFI protection compatible with heating cable.

2.12 SNOW MELTING AND DE-ICING CONTROLLER

- .1 Automatic controller to be used for snow melting system and de-icing system. Controller will automatically control heating cable and shall be compatible with all sensors provided for: de-icing and snow melting systems.
- .2 Adjustable hold-on timer (0-10 hours) and integral high-limit temperature sensor.
- .3 Wall mounted and rated Nema 4X.
- .4 Supply voltage 208 V, 1-ph and 24 A maximum current.
- .5 Built-in GFI protection compatible with heating cable.
- .6 Up to 6 sensors input.
- .7 Lead length up to 609 m.
- .8 Adjustment range 4°C to 32°C.
- .9 Operating temperature -40°C to 71°C.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for all heating cables installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install cables in accordance with manufacturer's instructions.

- .2 Place remote sensing bulb in RGS conduit in between heating cables 50 mm deep in concrete for rooms 103, 203, 204, 206, 208, 209, 210, 211 and 212. Cap and seal conduit.
- .3 Place remote sensing bulb in vandal-proof stainless steel recessed junction box complete with vandal-proof for rooms 210 and 209. Refer to Appendix A for approved Tamperproof screws requirements.
- .4 For electrical radiant heating and snow melting systems, project geometry allow for 60 mm space for embedded heating cable. See structure for placement of reinforcing steel for slab on grade.
- .5 Conceal all conduits.
- .6 Install cable straps fastened to concrete with 25 mm nails when 2 pour method used. Locate at 0.9 m intervals.
- .7 Secure cable to anchoring devices and confine cable within 150 mm minimum from edge of slab.
- .8 Protect heating cables with 13 mm plywood sheets and remove progressively when concrete topping is poured.
- .9 Install steel mesh anchoring system when hot mastic asphalt topping is installed, and secure cables to underside of wiring mesh.
- .10 Do not cross expansion joints with cable. Where structural design changes location of expansion joints, affecting snow melting cables, report to Departmental Representative.
- .11 Install heating cable with regular spacing and do not alter heating cable length.
- .12 Ensure cables do not bunch or cross.
- .13 Do not energize cable for 28 days after concrete pour.
- .14 Make power and control connections.
- .15 Ground cable and mesh to building grounding system.
- .16 Fasten floor warming cable to underside of slab on 400 mm centres.
- .17 Do not penetrate waterproofing membrane.

3.3 FIELD QUALITY CONTROL

- .1 Tests:
 - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .2 Use 500 V Megger to test cables for continuity and insulation value and record readings as follows:
 - .1 On cable reel.
 - .2 After installation.
 - .3 Before concrete pouring.
 - .4 During concrete pouring.
 - .5 24 hours after pouring.
 - .3 Where resistance of 50 megohms or less is measured, stop work and advise Departmental Representative.

3.4 TRAINING

- .1 Provide on-site lectures and demonstration by heat tracing and equipment manufacturer to train operational personnel in use and maintenance of heat tracing system.
- .2 Provide minimum of eight (8) hours of training. The time schedule of the training sessions to be coordinated with Departmental Representative.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for automatic load transfer equipment which can monitor voltage on all phases of normal power supply, initiate cranking of standby generator unit, transfer loads and shut down standby unit.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 20 - Waste Managing And Disposal.
- .3 Section 01 78 10 - Closeout Submittals.
- .4 Section 26 05 00 - Common Work Results - For Electrical.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN3-C13-M83(R1998), Instrument Transformers.
 - .2 CSA C22.2 No. 5-02, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).
 - .3 CSA C22.2 No. 178-1978(R2006), Automatic Transfer Switches.
- .2 American National Standards Institute (ANSI)/National Electrical Manufacturers Association (NEMA)
 - .1 ANSI/NEMA ICS 2-(R2005), Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.

1.4 SYSTEM DESCRIPTION

- .1 Automatic load transfer equipment to:
 - .1 Monitor voltage on phases of normal power supply.
 - .2 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time.
 - .3 Transfer load from normal supply to standby unit when standby unit reaches rated frequency and voltage pre-set adjustable limits.
 - .4 Transfer load from standby unit to normal power supply when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period.
 - .5 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Include:
 - .1 Single line diagram showing controls and relays.
 - .2 Description of equipment operation including:
 - .1 Automatic starting and transfer to standby unit and back to normal power.
 - .2 Test control.
 - .3 Manual control.
 - .4 Automatic shutdown.

1.6 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for automatic load transfer equipment for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.
- .2 Detailed instructions to permit effective operation, maintenance and repair.
- .3 Technical data:
 - .1 Schematic diagram of components, controls and relays.
 - .2 Illustrated parts lists with parts catalogue numbers.
 - .3 Certified copy of factory test results.

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20 - Waste Managing and Disposal
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Instrument transformers: to CAN3-C13.
- .2 Contactors: to ANSI/NEMA ICS2.

2.2 CONTACTOR TYPE TRANSFER EQUIPMENT

- .1 Contact Type Transfer Equipment: to CSA C22.2 No. 178.
- .2 Two 3 phase contactors mounted on common frame, in double throw arrangement, mechanically and electrically interlocked, motor solenoid operated, with CSA enclosure.
- .3 Rated: 600 V, 60 Hz, 4 wire, 3 pole, solid neutral.
- .4 Main contacts: silver surfaced, protected by arc disruption means.
- .5 Switch and relay contacts, coils, spring and control elements accessible for inspection and maintenance from front of panel without removal of switch panel or disconnection of drive linkages and power conductors.
- .6 Auxiliary contact: silver plated, to initiate emergency generator start-up on failure of normal power.
- .7 Fault withstand rating: 50 kA symmetrical for 3 cycles.
- .8 Lever to operate switch manually when switch is isolated.
- .9 Additional contactor to be installed for neutrals.

2.3 AUTOMATIC TRANSFER SWITCHES

- .1 Provide a complete factory assembled power transfer equipment with field programmable digital electronic controls designed for full automatic operation including: surge voltage isolation, voltage sensors on all phases of both sources, linear operator, permanently attached manual handles, positive mechanical and electrical interlocking, and mechanically held contacts for both sources.
- .2 The Transfer/Bypass Switches shall be housed in a freestanding, dead front, CSA Type 2 enclosure and shall provide adequate wire bend space. The cabinet door shall include permanently mounted key type latches.
- .3 All instruments, status indicators, and controls shall be mounted on the front of the cabinet.

- .4 Main contacts shall be rated for 600 Volts AC minimum.
- .5 Transfer switches shall be rated to carry 100% of rated current continuously in the enclosure supplied, in ambient temperatures of 40 to +60° C, relative humidity up to 95% (non condensing).
- .6 Transfer switches shall be double throw, electrically and mechanically interlocked, and mechanically held in the utility 1 and emergency 2 positions.
- .7 Transfer switches shall be equipped with permanently attached manual operating handles and quick break, quick make over centre contact mechanisms.
- .8 Main switch contacts shall be high pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
- .9 Transfer switches shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch and provided with a neutral bus and lugs. The neutral bus shall be sized to carry 100% of the current designated on the switch rating.
- .10 Field control connections shall be made on a common terminal block that is clearly and permanently labelled.
- .11 The transfer switches shall be Open Transition Transfer, when switch transfers load from utility to generator or back the transfer switch indexes to a neutral position to allow inductive motor load voltages to decay. The control system shall be capable of enabling or disabling this feature, and shall have an adjusting time period from 0 to 15 seconds.

2.4 TRANSFER SWITCH CONTROL

- .1 The Transfer switch shall be provided with a microprocessor control panel to allow the operator to view the status and control operation of the transfer switch. High Intensity LED lamps to indicate the source that the load is connected to (utility or generator) and which source(s) are available.
- .2 High intensity LED lamps to indicate that the transfer switch is "not in auto" (due to control being disabled or due to bypass switch (when used) enabled or in operation) and "Test/Exercise Active" to indicate that the control system is testing or exercising the generator set.

- .3 The transfer switch control shall include a System Control Switch with the following functions:
 - .1 OFF - the transfer switch automatic operation shall be disabled.
 - .2 AUTO - the transfer switch automatic sensing and operation is enabled.
 - .3 TEST - the generator set shall start and accelerate to rated speed and voltage and the transfer switch will switch to the emergency position until such time as the Test is deactivated. All preset control time delays will function.
 - .4 RESET- the switch shall be used to clear a fault any faults present in the control.
 - .5 "LAMP TEST" pushbutton that will simultaneously test all lamps on the panel by lighting them.
 - .6 AC Metering - transfer switch shall be equipped with a metering to provide the functions:
 - .1 Analog or digital voltmeter, ammeter, frequency meter, kilowatt (kW) meter and load power factor. Voltmeter and ammeter shall display all three phases.
 - .2 Voltage meter to display line to line and line to neutral. Metering accuracy to be within 0.5%.
 - .7 The microprocessor control shall allow the operator to set levels, enable or disable features and functions. Selected functions including voltage sensing levels and time delays shall be configurable using the operator panel. The control shall include as a minimum the following programmable transfer switch settings:
 - .1 Set nominal voltage and frequency for the transfer switch.
 - .2 Adjust voltage and frequency sensor operation set points.
 - .3 Set up time clock functions.
 - .4 Set up load sequence functions.
 - .5 Enable or disable control functions in the transfer switch.
 - .1 Set time delays for transfer time, time delay start, stop, transfer, and retransfer.
 - .8 The microprocessor control shall incorporate the following system monitoring:
 - .1 Monitor all phases of the utility source for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of normal voltage level).

- .2 Monitor all phases of the emergency source for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of pickup voltage level).
- .3 Monitor all phases of the utility source and emergency source for voltage imbalance.
- .4 Monitor all phases of the utility source and emergency source for phase rotation.
- .5 Monitor all phases of the utility source and emergency source for over voltage conditions (adjustable for dropout over a range of 105 to 135% of normal voltage, and pickup at 95-99% of dropout voltage level).
- .6 Monitor all phases of the utility source and emergency source for over or under frequency conditions.
- .7 Monitor the neutral current flow in the load side of the transfer switch. The control shall initiate an alarm when the neutral current exceeds a preset adjustable value in the range of 100-150% of rated phase current for more than an adjustable time period of 10 to 60 seconds.
- .9 The transfer switch control shall incorporate adjustable time delays for generator set start (adjustable in a range from 0-15 seconds); transfer (adjustable in a range from 0-120 seconds); retransfer (adjustable in a range from 0-30 minutes); and generator stop.
- .10 The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.
- .11 The transfer switch will provide an isolated relay contact for starting of the generator set. The relay shall be normally held open, and close to start the generator.
- .12 Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 Amps, 250 VAC.

2.5 MANUAL BYPASS

- .1 Bypass switch shall be integral to the transfer switch assembly and shall provide a means for manually bypassing the transfer switch from either source (utility or emergency) without disturbance of the supply to the load. The bypass shall isolate the transfer switch from both sources for maintenance or repair.

- .2 Bypass isolation switch equipment shall be CSA Approved with continuous current rating, voltage and frequency ratings, and withstand and closing ratings equal to the transfer switch.
- .3 Mechanical interlocks shall prevent all possible source to source interconnections. Designs which depend on electrical interlocks to prevent source to source interconnections, or which intentionally interconnect the sources, are not acceptable. The interlock system shall assure a properly sequenced, mechanically guided bypass and isolation action.
- .4 A draw-out isolation mechanism shall provide closed-door isolation of the transfer switch, using a permanently mounted, external handle. The isolation mechanism shall be interlocked so that either the transfer switch must be bypassed or the transfer switch must be open, before the mechanism will permit isolation of the transfer switch.
- .5 The isolation mechanism shall provide for three-position operation; Connected, Test, and Isolated. In the Connected position, isolation contacts shall be fully engaged and closed. In the Test position, isolation contacts shall be open and the transfer switch control connected. The Test position shall allow operational testing of transfer switch and controls without power disruption to the load. In the Isolated position, the transfer switch and control shall be completely isolated from all power sources. In the isolated position, safety shutters shall close to cover bypass switch power terminals minimizing the possibility of accidental contact with energized parts.

2.6 CONTROLS TRANSFORMERS

- .1 Control transformers: dry type with 120 V secondary to isolate control circuits from:
 - .1 Normal power supply.
 - .2 Emergency power supply.
- .2 Relays: continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:
 - .1 Voltage sensing: 3 phase for normal power and on one phase only for emergency, solid state type, adjustable drop out and pick up, close differential, 2 V minimum undervoltage and over voltage protection.
 - .2 Time delay: normal power to standby, adjustable solid state, 0 to 60 seconds.

- .3 Time delay on engine starting to override momentary power outages or dips, adjustable 0 to 60 seconds delay.
 - .4 Time delay on retransfer from standby to normal power, adjustable 20 seconds to 10 minutes.
 - .5 Time delay for engine cool-off to permit standby set to run unloaded after retransfer to normal power, adjustable solid state, 0 to 60 seconds, 5 seconds intervals to 180 seconds, 20 seconds intervals to 10 minutes.
 - .6 Frequency sensing, to prevent transfer from normal power supply until frequency of standby unit reaches preset adjustable values.
- .3 Solid state electronic in-phase monitor.

2.7 ACCESSORIES

- .1 4 (four) Field programmable time delay contact (delay from 10 s to 10 mn). Time delay shall change the state when in emergency and change to its original state after delay occurs.
- .2 Pilot lights to indicate power availability normal and standby, switch position, green for normal, red for standby, mounted in panel remote.
- .3 Plant exerciser: 168 hour timer to start standby unit once each week for selected interval but does not transfer load from normal supply transfers load to emergency supply and retransfers to normal supply on standby unit shutdown. Timer adjustable 0-168 hour in 15 minutes intervals.
- .4 Auxiliary relay to provide 2 N.O. and 2 N.C. contacts for remote alarms.
- .5 Potential transformers - dry type for indoor use:
 - .1 Ratio: 300 to 120.
 - .2 Rating: 600 V, 60 Hz, BIL kV.
- .6 Current transformers - dry type for indoor use:
 - .1 Ratio: to match switch rating.
 - .2 Rating: 600 V, 60 Hz.
 - .3 Positive action automatic short-circuiting device in secondary terminals.

2.8 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results - For Electrical.
- .2 Control panel:
 - .1 For selector switch and manual switch: size 5 nameplates.
 - .2 For meters, indicating lights, minor controls: size 3 nameplates.

2.9 SOURCE QUALITY CONTROL

- .1 Complete equipment, including transfer mechanism, controls, relays and accessories factory assembled and tested in presence of Departmental Representative.
- .2 Notify Departmental Representative 10 days in advance of date of factory test.
- .3 Tests:
 - .1 Operate equipment both mechanically and electrically to ensure proper performance.
 - .2 Check selector switch, in modes of operation Test, Auto, Manual, Engine Start and record results.
 - .3 Check voltage sensing and time delay relay settings.
 - .4 Check:
 - .1 Automatic starting and transfer of load on failure of normal power.
 - .2 Retransfer of load when normal power supply resumed.
 - .3 Automatic shutdown.

2.10 SUPPLIER

- .1 The automatic transfer switch shall be supplied by the diesel generator manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Locate, install and connect transfer equipment.
- .2 Check relays solid state monitors and adjust as required.
- .3 Install and connect battery and remote alarms.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical.
- .2 Energize transfer equipment from normal power supply.
- .3 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.
- .4 Set selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for 10 minutes, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown.
- .5 Repeat, at 1 hour intervals, times, complete test with selector switch in each position, for each test.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 28 - Grounding - Secondary.
- .2 Section 26 24 02 - Service Entrance Board.
- .3 Section 26 27 26 - Wiring Devices.
- .4 Section 28 31 00.01 – Multiplex Fire Alarm System.

1.2 REFERENCES

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41.1, IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.
 - .2 IEEE C62.41.2, IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
 - .3 IEEE C62.45, IEEE Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and Less) AC Power Circuits.
- .2 Underwriters' Laboratories of Canada (ULC)
 - .1 UL 1283 - Electromagnetic Interference Filters.
 - .2 UL 1449 3rd Edition - Standard for Safety for Surge Protective Devices.
- .3 NEMA LS-1-1992, Low Voltage Surge Protection Devices.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for surge protective devices and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Units Performance Characteristic.
 - .2 Units Features.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for surge protection devices for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect surge protection devices from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 20 - Waste Managing and Disposal.

PART 2 PRODUCTS

2.1 SURGE PROTECTIVE DEVICE (SPD)

- .1 Location category: B - indoor service entrance.
- .2 Exposure level: 2 - medium.
- .3 Operational condition:
 - .1 Temperature: -40°C to +60°C.
 - .2 Humidity: 95% RH, non-condensing atmosphere.
 - .3 Altitude: 0 - 3600 m.
 - .4 Frequency: 60 Hz.
 - .5 Nominal Voltage: 347/600 Volts.
- .4 SPD shall be MOV based, tested per IEEE C62.41.1.
- .5 SPD component parts: to UL 1449 3rd Edition, NEMA LS 1, UL 1283 and cUL.
- .6 SPD characteristics:
 - .1 Protective mode: line-to-line, line-to-neutral, line-to-ground, neutral-to-ground.
 - .2 Clamping voltage to UL-1449:
 - .1 Mode L-N N-G L-G L-L.
 - .2 Volts 1000 1000 1000 1800.
 - .3 Maximum surge current 120 kA per mode (240 kA per phase).
 - .4 MCOV (maximum continuous operating voltage): greater than 115% of nominal (L-G).
 - .5 Radio influence attenuation: less than or equal to -50 dB @ 100 kHz.
 - .6 Filter band width: 10 kHz to 100 MHz.
 - .7 Response time: less than or equal to 1 ns.
 - .8 Integral fusing.
 - .9 Approved disconnect means.

- .7 Features:
 - .1 Monitoring of internal fuses and MOV's.
 - .2 Status indicator lights on each phase.
 - .3 Trouble light.
 - .4 SPDT (form C) auxiliary contact.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for secondary lightning arresters installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 SPD device shall be located as close as possible to the protected equipment (panel or switchboard). Lead length shall not exceed 600 mm.
- .2 Connect SPD as per manufacturer recommendations.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Managing.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 - Waste Managing and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 45 00 – Quality Control.
- .3 Section 01 74 20 – Waste Managing and Disposal.
- .4 Section 26 09 25 – Vandal Resistant Lighting Control Devices.
- .5 Section 26 09 43 – Network Lighting Controls.
- .6 Section 26 52 00 - Emergency Lighting.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI)
 - .1 ANSI C82.1-04, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
- .2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
- .3 ASTM International Inc.
 - .1 ASTM F 1137-00(2006), Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .4 Canadian Standards Association (CSA International)
- .5 ICES-005-07, Radio Frequency Lighting Devices.
- .6 Underwriters' Laboratories of Canada (ULC)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.

- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Provide complete photometric data prepared by independent testing laboratory for luminaires where specified, for approval by Departmental Representative.
 - .3 Photometric data to include: VCP Table where applicable spacing criterion; 5 plane candlepower summary and lumen ratings.
- .3 Quality assurance submittals: provide following in accordance with Section 01 45 00 - Quality Control.
 - .1 Manufacturer's instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .3 Packaging Waste Management: remove for reuse and return packaging materials.
- .4 Divert unused metal materials from landfill to metal recycling facility.

PART 2 PRODUCTS

2.1 LAMPS AND LED

- .1 Refer to Luminaire Schedules on drawings.
- .2 Average life cycle of 30,000 hours based on 3-hour duty.
- .3 Shall be CEE listed.
- .4 The lamp colour and CRI index as indicated on drawings.

2.2 BALLASTS

- .1 Fluorescent ballast: CBM and CSA certified, energy efficient type, IC electronic programmed rapid start design FB1.
 - .1 Rating: 120 V, 60 Hz, for use with 2-32 W, T8 lamps.
 - .2 RFI/EMI suppression circuit to: FCC (CFR47) Part 18, sub-part C, Class A and Part 15, sub-part B, Class B.
 - .3 Totally encased and designed for 40°C ambient temperature.
 - .4 Power factor: minimum 99% with 95% of rated lamp lumens.
 - .5 Crest factor: 1.5 maximum current, 2.0 maximum voltage.
 - .6 Harmonics: 10% maximum THD, including 49th for electronic discrete and hybrid ballasts.
 - .7 Operating frequency of electronic ballast: 21 khz minimum.
 - .8 Total Circuit Power: 56 Watts.
 - .9 Ballast Factor: 0.88.
 - .10 Sound rated: Class A.
 - .11 Mounting: integral with luminaire.
 - .12 Ballasts shall be NEMA premium quality (no substitutes) and CEE specifications compliant.
 - .13 Ballast to operate 1 or 2 lamps, as required by luminaire schedule.

2.3 LED FIXTURE DRIVER

- .1 Integral to the fixture and from the same manufacturer.
- .2 Refer to Luminaire Schedule on drawings.

2.4 FINISHES

- .1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.5 OPTICAL CONTROL DEVICES

- .1 As indicated on drawings.

2.6 LUMINAIRES

- .1 As indicated in Luminaire Schedule.
- .2 Refer to Appendix A for approved Tamperproof screws for vandal resistant fixtures.

2.7 SURGE PROTECTION DEVICES

- .1 LED outdoor Area Luminaires shall be completed with surge protection devices.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.
- .2 Provide adequate support to suit ceiling system.
- .3 Utilize an individual, dedicated neutral conductor for each lighting circuit. Common or shared neutral are not permitted.

3.2 WIRING

- .1 Connect luminaires to lighting circuits.

3.3 LUMINAIRE SUPPORTS

- .1 For suspended ceiling installations support luminaires independently of ceiling.

3.4 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.5 CLEANING

- .1 Clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for reuse and recycling, in accordance with Section 01 74 20 – Waste Managing and Disposal.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 21 - Wires and Cables (0-1000 V).
- .2 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .3 Section 26 50 00 - Lighting.

1.2 REFERENCES

- .1 CSA International
 - .1 CSA C22.2 No.141-10, Emergency Lighting Equipment.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for emergency lighting and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for emergency lighting for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect emergency lighting from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return of packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 20 –Waste Managing and Disposal.

1.6 WARRANTY

- .1 For batteries in this Section 26 52 00 - Emergency Lighting, 12 months warranty period is extended to 120 months. Battery shall be pro-rated after five (5) years.

PART 2 PRODUCTS

2.1 EQUIPMENT

- .1 Emergency lighting equipment: to CSA C22.2 No.141.
- .2 Supply voltage: 120 VAC input.
- .3 Output voltage: as indicated on drawings.
- .4 Operating time: 60 minutes minimum.
- .5 Battery: sealed, maintenance free.
- .6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.
- .7 Solid state transfer circuit.
- .8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.

- .9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.
- .10 Lamp heads: integral on unit, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED. Rating as indicated on drawings.
- .11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.
- .12 Housing:
 - .1 Thermoplastic polycarbonate.
 - .2 Where vandal resistant is indicated housing to be 20 gauge steel construction with wrap-around steel cover plate. To come complete with heavy-duty one piece, molded lamp assembly shields.
- .13 Finish: white.
- .14 Auxiliary equipment:
 - .1 Test switch.
 - .2 Time delay relay.
 - .3 Battery disconnect device.
 - .4 AC input and DC output terminal blocks inside cabinet.
 - .5 Bracket.
- .15 Refer to Appendix A for approved Tamperproof screws.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install unit equipment.
- .2 Direct heads.
- .3 Connect exit lights to unit equipment.
- .4 Test and demonstrate successfully the operation of all emergency lighting. Test each unit for 30 minutes on emergency.

3.2 ILLUMINATION MEASUREMENT

- .1 Measure and record emergency lighting illumination in accordance with the following:
 - .1 Verify all emergency lighting equipment is fully operational.
 - .2 Verify construction including building finishes are complete in areas illuminated by emergency lighting equipment.
 - .3 Verify calibrated light meter suitable for emergency lighting measurement is available.
 - .4 Simulate building utility power failure during non-daylight time period. Return building utility power service upon completion of illumination measurements.
 - .5 Utilize light meter to measure illumination (LUX) in all areas with emergency lighting equipment. Record measurements on detailed floor area grid plans based on building floor plans.
 - .6 Submit illumination measurement report including two (2) copies of illumination measurements on grid floor plans.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20 – Waste Managing and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by emergency lighting installation.

PART 1 GENERAL

1.1 RELATED WORK

- .1 Section 26 52 00 - Emergency Lighting.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.141-10, Emergency Lighting Equipment.
 - .2 CSA C860-11, Performance of Internally-Lighted Exit Signs.
- .2 National Building Code of Canada (NBCC)
 - .1 NRCC NBCC-2010.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Submit WHMIS MSDS - Material Safety Data Sheets
- .4 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20 – Waste Managing and Disposal.

1.5 WARRANTY

- .1 For batteries in this Section 26 53 00 - Exit Signs: 12 months warranty period is extended to 120 months. Battery shall be pro-rated after five (5) years.

PART 2 PRODUCTS

2.1 SELF-POWERED UNITS

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860.
- .2 Housing:
 - .1 Rugged steel housing, with steel contour face and back plates.
 - .2 Where vandal resistant is indicated, housing to be 16 gauge heavy-duty steel construction with solid durable wrap-around faceplate. To include integral polycarbonate shield behind faceplate, and stainless steel vandal-proof screws.
- .3 Lamps: LED, 12 VDC.
- .4 Use pictographs type with running person with green colour in accordance with NBCC.
- .5 Face plate to remain captive for relamping.
- .6 Supply voltage: 120 VAC input.
- .7 Output voltage: 12 VDC.
- .8 Operating time: 60 minutes minimum.
- .9 Recharge time: 12 hours.
- .10 Battery: sealed, maintenance free.
- .11 Charger: solid state, voltage/current regulated, inverse temperature compensated, short circuit protected, with regulated output of plus or minus 0.01 V for plus or minus 10% V input variation.
- .12 Solid state transfer circuit.
- .13 Refer to Appendix A for approved Tamperproof screws.

- .14 Mounting: suitable for universal mounting directly on junction box and c/w knockouts for conduit.
 - .1 Removable or hinged front panel for easy access to batteries.
- .15 Arrow: Knock-outs.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 INSTALLATION

- .1 Install exit lights to manufacturer's recommendations, listing requirements, NBCC standard and local regulatory requirements.
- .2 Connect fixtures to exit light circuits.
- .3 Ensure that exit light circuit breaker is locked in on position.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 26 50 00 - Lighting.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.206-M1987(R2008), Lighting Poles.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20 - Waste Managing and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.1 POLES

- .1 Poles: to CSA C22.2 No.206 designed for underground wiring and:
 - .1 Mounting on concrete anchor base.
 - .2 Steel square straight heavy duty pole.
 - .3 Nominal height 6 meters.
 - .4 Baseplate and hand hole (access handhole 450 mm above pole base for wiring connections, with welded-on reinforcing frames bolted-on cover), and removable cap.
 - .5 Shaft: 152.4 mm square tube shaft.
 - .6 Shaft wall thickness: 4.78 mm.
 - .7 Anchor bolts: size as per manufacturer recommendations, steel with shims, nuts, washers and covers.
 - .8 Grounding lug.
 - .9 Pole shall be designed to withstand 160 kPH wind load.
 - .10 Finish: Powder coat black

2.2 LUMINAIRE MOUNTING BRACKETS

- .1 Mounting brackets for specified luminaires:
 - .1 Single and twin brackets as indicated in on drawings.
 - .2 Arm extension length as indicated in Luminaire Schedule.
 - .3 Type: cantilever.
 - .4 Finish: powder coat black.

2.3 LUMINAIRES

- .1 Refer to Luminaire Schedule.

2.4 BOLLARD

- .1 Refer to Luminaire Schedule.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install poles and bollards true and plumb, complete with brackets in accordance with manufacturer's instructions.
- .2 Install luminaires on pole and install lamps.
- .3 Check luminaire orientation, level and tilt.
- .4 Connect luminaire to lighting circuit.
- .5 Connect Bollard to lighting circuit.
- .6 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

PART 1 GENERAL

1.1 GENERAL

- .1 Main Telecom Room (MTR) refer to Room 120.
- .2 Telecommunication (TR) refer to Room 121.

1.2 RELATED SECTIONS

- .1 Section 26 05 28 - Grounding Secondary.
- .2 Section 27 05 28 – Pathways For Communications Systems.
- .3 Section 27 10 05 – Structured Cabling For Communications Systems.

1.3 REFERENCES

- .1 American National Standards Institute
 - .1 ANSI J-STD-607-A-2002, Joint Standard - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
- .2 Telecommunications Industries Association (TIA)/Electronic Industries Alliance (EIA)
 - .1 TIA/EIA-606-2002, Administration Standard for the Commercial Telecommunications Infrastructure.
- .3 U.S. Department of Labor/Occupational Safety and Health Administration (OSHA)
 - .1 Nationally Recognized Testing Laboratory (NRTL).
- .4 Grounding and Bonding for Telecommunications in Commercial buildings CAN/CSA-T527-1999.

1.4 SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit product data for ground bar.

1.5 SYSTEM DESCRIPTION

- .1 Telecommunications grounding and bonding system consisting of grounding busbars, bonding backbones, and other bonding conductors.
- .2 Provides ground reference for telecommunications systems within the building and for telecommunications rooms.
- .3 Metallic pathways, cable shields, conductors, and hardware within telecommunications spaces are bonded to the telecommunications grounding and bonding system.
- .4 Provides grounding for radio system.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal:
 - .1 Separate waste materials in accordance with Section 01 74 20 - Waste Managing and Disposal.

PART 2 PRODUCTS

2.1 TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)

- .1 Insulated predrilled copper busbar, listed and approved by NRTL, electrotin plated with holes 8 mm diameter for use with standard-sized lugs to: ANSI J-STD-607-A.
- .2 Dimensions: 6 mm thick, 100 mm wide, 254 mm long, to: ANSI J-STD-607-A.

2.2 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

- .1 Insulated predrilled copper busbar, listed and approved by NRTL, electrotin plated with holes 8 mm diameter for use with standard-sized lugs to: ANSI J-STD-607-A.
- .2 Dimensions: 6 mm thick, 50 mm wide, 254 mm long, to: ANSI J-STD-607-A.

2.3 BONDING CONDUCTOR FOR TELECOMMUNICATIONS (BCT)

- .1 2/0 AWG stranded copper conductor, green insulated marked to: ANSI J-STD-607-A.

2.4 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

- .1 2/0 AWG stranded copper conductor, green insulated marked to: ANSI J-STD-607-A.
- .2 Non-metallic warning labels in English to: ANSI J-STD-607-A.

2.5 WARNNIG LABELS

- .1 Identify labels with wording "If this connector is loose or must be removed, please call the building telecommunications manager".

PART 3 EXECUTION

3.1 TELECOMMUNICATIONS MAIN GROUNDING BUSBAR (TMGB)

- .1 Install TMGB on the wall of Room 120 adjacent to the cable entrance conduits, 150 mm from the corner of the room and 150 mm above finished floor.
- .2 Insulate TMGB from its support by 50 mm.

3.2 TELECOMMUNICATIONS GROUNDING BUSBAR (TGB)

- .1 Install TGB on the wall of Room 121 adjacent to the cable entrance sleeves, 150mm from the corner and 150 mm above finished floor.
- .2 Insulate TGB from its support by 50 mm.

3.3 BONDING CONDUCTORS GENERAL

- .1 When placed in ferrous metallic conduit or EMT, bond conductors to each end of the conduit or EMT using grounding bushing 6 AWG green jacketed stranded copper conductor.

3.4 BONDING CONDUCTOR FOR TELECOMMUNICATIONS

- .1 Install bonding conductor for telecommunications from the electrical service equipment (power) ground (main Building ground) to the TMGB in Room 120.
- .2 Use approved 2 hole compression lugs for connection to TMGB.
- .3 Bonding conductor for telecommunications (BCT) to be connected to the electrical service equipment (power) ground (main Building ground) by a qualified personnel.

3.5 TELECOMMUNICATIONS BONDING BACKBONE (TBB)

- .1 Install TBB from TMGB to TGB as indicated.
- .2 Connect TBB to TMGB and TGB using approved 2 hole compression lugs.

3.6 BONDING TO TMGB

- .1 Bond metallic raceways in Room 120 to TMGB using 6 AWG green insulated copper conductor.
- .2 For cables within Room 120 having shield or metallic member, bond shield or metallic member to TMGB using 6 AWG green insulated copper conductor.

- .3 Bond equipment racks and cabinets located in Room 120 to TMGB using 6 AWG green insulated copper conductor.

3.7 BONDING TO TGB

- .1 Bond metallic raceways in Room 121 to TGB using 6 AWG green insulated copper conductor.
- .2 For cables within Room 121 having shield or metallic member, bond shield or metallic member to TGB using 6 AWG green insulated copper conductor.
- .3 Bond equipment rack and cabinets located in Room 121 equipment room to TGB using 6 AWG green insulated copper conductor.
- .4 Bond static dissipative flooring to TGB in accordance with manufacturer's recommendations using 6 AWG green insulated copper conductors.

3.8 LABELLING

- .1 Apply warning labels to telecommunications bonding and grounding conductors.
- .2 Apply additional administrative labels to: TIA/EIA-606.

PART 1 GENERAL

1.1 GENERAL

- .1 Main Telecom Room (MTR) refer to Room 120.
- .2 Telecommunication (TR) refer to Room 121.

1.2 RELATED SECTIONS

- .1 Section 01 74 20 - Waste Managing and Disposal.
- .2 Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .3 Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
- .4 Section 27 05 26 - Grounding and Bonding for Communications Systems.
- .5 Section 27 10 05 – Structured Cabling For Communications Systems.

1.3 REFERENCES

- .1 TIA/EIA-569 Commercial Building Standard for Telecommunications Pathway and Spaces.
- .2 TIA/EIA-607 Commercial Building Grounding (Earthing) and Bond Requirements for Telecommunications.

1.4 SYSTEM DESCRIPTION

- .1 Empty communications (data/voice/radio outlets) raceways system consists of cable trays, outlet boxes, distribution conduits, pull boxes, sleeves and caps, and fish wires. Complete system to support CAT 6 rated communications cabling installation and operations.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20 - Waste Managing and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal, conduit and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.
- .5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.1 MATERIAL

- .1 Conduits: EMT type, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings. Conduit minimum size 27 mm.
- .2 Pull boxes: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .3 Outlet boxes EMT type and fittings: in accordance with Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets. Double gang boxes, minimum 100 mm by 100 mm by 70 mm deep complete with matching single gang plaster rings.
- .4 Fish wire: polypropylene type.
- .5 Cable trays: as indicated on drawings.

2.2 CABLE TRAY

- .1 All cable trays shall be wire basket tray trough type, prefabricated structure 300 mm in width or greater. A wire basket tray shall be equipped with two side rails minimum height of 50 mm. It shall be welded steel wire construction, Safe-T-Edge design which eliminates sharp edges and creates a smooth cable pathway.

Install a wire basket tray in the horizontal cable distribution system above ceilings and in raised floor area. A cable ladder rack system shall be installed within Room 121.

- .2 Support cable trays to suit loading and support requirements in the Canadian Electrical Code, 2012.
- .3 For the applicable class, support shall be placed within a maximum of 610 mm on either side of any connection to a fitting.
- .4 Materials bolted or riveted to the cable tray shall be free of burrs and or sharp edges. Do not allow bolts and or rivets to obstruct or interfere with the interior space of the tray.
- .5 All metal cable trays shall be bonded together and to the TGB.
- .6 The trays shall be coated to prevent rust or galvanic action and shall be available in aluminum, stainless steel 316, and pre-galvanized or hot dip galvanized steel.
- .7 Accessories and fittings such as elbows, reducers, shall be manufactured by the cable tray manufacturer and match tray size.
- .8 Install cable trays at least 300 mm away from fluorescent luminaries and cross power cables at right angles.
 - .1 The minimum clearances for cable trays shall be in accordance with Canadian Electrical Code C22.1-12.
 - .2 300 mm Vertical clearance from the top of cable trays to all ceilings, heating ducts, and heating equipment and 150 mm for short length obstructions.
 - .3 600 mm Horizontal clearance on one side of cable tray mounted adjacent to one another or to walls or other obstructions.
- .9 Acceptable material:
 - .1 Legrand Cablofil.
 - .2 Hubbell.
 - .3 Thomas & Betts.

2.3 CABLE RADIUS DROPS

- .1 Cable radius drops are to be provided in all locations where cable is to drop out of the bottom of the tray.
- .2 Provide two cable radius drops for each equipment rack. Radius drops shall be of the same size as the ladder racking.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install raceway system, fish wire, outlet boxes, pull boxes, cover plates, conduit, sleeves and caps, miscellaneous and positioning material to constitute complete system.
- .2 All conduits shall originate and be physically connected to the telecom backboards in the MTR or Telecommunication Room, cable tray and pull box.
- .3 All conduits/sleeves that enter the MTR/TR or terminate at any cable tray shall be fitted with an approved ground bushing c/w ground lug and bonded together mechanically. This shall be connected to the approved building ground by means of a No. 6 AWG to the grounding bus bar for conduits originating in the MTR/TR. For conduits originating from a cable tray, mechanically bond to tray.
- .4 All conduits entering or exiting through the ceiling or walls of the MTR and TR shall protrude into the room 25-50 mm.
- .5 Where crossing fire rated walls, cable tray to transition to conduit to pass through wall. Tray may be used again after passing through fire rated wall.
- .6 Riser sleeves in the Main Telecom Room and Telecommunication Rooms shall protrude through the floor 50-75 mm above finished floor (AFF).
- .7 All conduits shall be thin wall EMT, reamed and bushed at both ends and bonded to the distribution system. Rigid PVC or flexible metallic or PVC conduits are NOT acceptable.
- .8 Pull boxes shall be installed at a reasonable height, in an exposed location and such that access for installation of cables is not prohibited. Pull boxes shall not be placed in a fixed false ceiling space, unless immediately above a suitably marked and hinged access panel. Provide indicator decals on ceiling T-bar rail or ceiling tiles showing location of pull box or splice box.
- .9 All conduit runs shall be a maximum of 30 meters (100ft) in length with a maximum of two (2) 90 degree bends between pull points.
- .10 Pullboxes are not to be used for changes of direction; all wiring is to be pulled straight through and direction changes are to be via conduit elbows past the pullbox.
- .11 Use soft vertical offset.
- .12 The use of J hooks, brackets, cable ties and other attachments is not permitted.

- .13 The inside radius of a bend in a conduit shall be not less than six times the internal diameter when the conduit is less than 50 mm in diameter and ten times the internal diameter when conduit is 50 mm in diameter or larger.
- .14 Soft 90 degree bends are to be used for cable tray offsets (tray risers and drops).
- .15 All zone conduits shall be identified and labeled at both ends. Tags shall identify start and finish of conduit runs. Pull boxes shall be labeled on the exposed exterior.
- .16 All metallic parts of the cable distribution supporting system shall be bonded together mechanically, including at all transition points (i.e. cable tray and distribution conduit not mechanically connected) using a 6 AWG green jacketed stranded copper ground wire. The metallic components of the cable distribution system shall be bonded together at the MTR and TR's and then bonded to their respective telecom ground bus bars.
- .17 All fittings, connectors and couplings are to be steel.
- .18 Where EMT is used in slab, use concrete tight couplings. Do NOT use EMT or aluminum conduit in concrete slab.
- .19 All conduits shall be equipped with approved type expansion joints and clamps whenever conduits cross expansion joints of building.
- .20 Conduit shall be installed at a minimum of 152 mm from heating pipes not insulated and a minimum of 200 mm from all electrical cabling.
- .21 All wall and floor penetrations shall be packed or sealed with an approved fire retardant sealing compound around the conduit.
- .22 All conduits shall be supported independently of the suspended ceiling. Conduits NOT to be anchored to suspended ceiling connection rods.
- .23 All conduits/sleeves that enter the MTR or any TR shall be fitted with an approved ground bushing c/w ground lug and bonded together mechanically (one continuous piece preferred). This shall be connected to the approved building ground by means of a No. 6 AWG to the grounding bus bar.
- .24 All conduit runs shall follow building grid lines and shall be concealed where possible.
- .25 A pull box shall be placed in conduit runs where the sum of the bends exceeds 180 degrees, where the overall length of the conduit run is more than 30m, or if there is a reverse bend in the run.
- .26 Pull boxes shall be constructed and sized in accordance with Canadian Electrical Code and TIA/EIA standards of code gauge steel and shall have a rust resistant finish.

- .27 Conduit must enter the outlet boxes from the top or bottom.
- .28 All conduit shall be installed in accordance with Canadian Electrical Code, Part 1 Section 12, applicable building codes and TIA/EIA 569.
- .29 The minimum size (inside diameter) for EMT conduit running between the Main Telecom Room or a Telecommunications Room and the Telecommunications outlet at an outlet location is twenty-seven millimeters (27 mm).
- .30 The maximum horizontal cable run distance not to exceed 90 metres. The cable length from the mechanical termination in the TR and MTR rooms to the Telecommunications outlet. Where the horizontal distance exceeds 90 meters, provide additional rooms as required.
- .31 Cable fill capacities of conduit, cable tray and raceways shall not be greater than 40%.
- .32 Future requirements for additional cables to each outlet shall be considered.
- .33 A pull cord or fish tape shall be installed in all conduits.
- .34 The telecommunications outlet conduit system shall be labeled green.
- .35 Place pull boxes in readily accessible locations only.
- .36 The use of LB, LL and LR type fittings is not permitted.
- .37 Conduits ending in the vicinity of a cable tray shall be terminated at a height of no less than 100mm and no more than 150mm from the top of the cable tray. Conduit runs shall not be punched through the side of the cable tray. Conduit ends are to be bonded to the cable tray. Installer is to ensure that the bonding cable is secured to the outside of the cable tray.
- .38 All conduits crossing an SDA (Sensitive Discussion Area) rated wall shall be spaced 75 mm (3") minimum such that the drywall can be sealed fully all around.

PART 1 GENERAL

1.1 RELATED SECTION

- .1 Section 26 05 31 – Splitters, Junction, Pull Boxes and Cabinets.
- .2 Section 26 05 34 – Conduits, Conduit Boxes and Fittings.
- .3 Section 27 05 26 – Grounding and Bonding for Communications Systems.
- .4 Section 27 05 28 – Pathways for Communications Systems.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-C22.2 No. 214-08(R2013), Communications Cables (Bi-National standard with UL 444).
- .2 Telecommunications Industry Association (TIA)/Electronic Industries Alliance (EIA)
 - .1 TIA/EIA-568-C.0-(2009), Generic Telecommunications Cabling for Customer Premises.
 - .2 TIA/EIA-568-C.1-(2009), Commercial Building Telecommunications Cabling Standard.
 - .3 TIA/EIA-568-C.2-(2009), Balanced Twisted-Pair Telecommunications Cabling Standard.
 - .4 TIA/EIA-606-A-(2002), Administration Standard for the Commercial Telecommunications Infrastructure.
 - .5 TIA-569-C, Commercial Building Standard for Telecommunications Pathways and Spaces.
 - .6 ANSI-J-STD-607-A Commercial Building Grounding and Bonding Requirements for Telecommunications.
 - .7 TIA Spec J-STD-607-A.
- .3 TBITS 6.9 - Treasury Board Information Technology Standard.
- .4 Canadian Electrical Code (2012).

1.3 DEFINITIONS

- .1 Refer to TIA/EIA-598-C, Annex A for definitions of terms, distribution, and breakout cables.

1.4 NEW TELEPHONE SERVICES

- .1 This building shall have a new Data, Voice and CATV utility service.
- .2 Contact, coordinate and arrange to obtain new communication service from the local telephone utility.
- .3 Provide the underground duct as shown on drawing. Coordinate with local utility representative before installation.
- .4 Pay for all associated fees.

1.5 SYSTEM DESCRIPTION

- .1 Structured telecommunications wiring system consist of unshielded-twisted-pair cables, terminations, connectors, cross-connection hardware and related equipment installed inside building for occupant's telecommunications systems, including voice (telephone), data and radio.
- .2 Installed in physical star configuration with separate horizontal and backbone sub-systems.
 - .1 Horizontal cables link work areas to telecommunications rooms located on same floor.
 - .2 Telecommunications rooms linked to main terminal/equipment room by backbone cables.
 - .3 Locate voice equipment in Room 120 and locate data equipment in Room 121.

1.6 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 As-built Records and Drawings:
 - .1 Provide Microsoft Access database reflecting cable installation and cross-connections.
 - .2 Provide electronic drawings in AutoCAD format depicting all construction. AutoCAD version to be coordinated with Departmental Representative.
 - .3 Provide two (2) bound complete hard-copy sets of as-built records to the Departmental Representative.
 - .1 Provide and place one hard copy of as-built records for each telecommunications room in plan holder in each telecommunications room.

1.7 QUALITY ASSURANCE

- .1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 20 - Waste Managing and Disposal.

1.9 CONTRACTOR QUALIFICATION

- .1 All work included in this section shall be performed by staff holding a designation of Registered Communications Distribution Design (RCDD).

PART 2 PRODUCTS

2.1 FOUR-PAIR 100 OHM BALANCED TWISTED PAIR CABLE (VOICE/DATA)

- .1 Four-pair, 100 ohm balanced unshielded-twisted-pair (UTP) cable, flame test classification FT6 to: CSA-C22.2 No. 214, Category 6 (Cat 6) to: TIA/EIA-568-C.2.
- .2 Purple jacket for data cable and white for voice cable.

2.2 FOUR-PAIR 100 OHM BALANCED TWISTED PAIR CABLE (RADIO)

- .1 Four-pair, yellow jacket, 100 ohm balanced unshielded-twisted-pair (UTP) cable, flame test classification FT6 to: CSA-C22.2 No. 214, Category 6 (Cat 6) to: TIA/EIS-568-C.2.
- .2 Approved manufacturer: Beldon.

2.3 MULTI-PAIR 100 OHM BALANCED TWISTED PAIR CABLE

- .1 100ohm, color coded 25 pair binder groups, number of pairs, sheath consists of thermoplastic jacket without underlying metallic shield, Category 3 to: TIA/EIA-568-C.2, flame test classification FT6 to: CSA-C22.2 No. 214.

2.4 WORK AREA UTP 4-PAIR MODULAR JACK (VOICE/DATA)

- .1 Eight-position modular jack ("RJ-45"), type T568A Category 6 to: TIA/EIA-568-C.2:
 - .1 Mounted in compatible, minimum 4 position, modular, angled, keystone type faceplate, 3 RJ-45 jack positions per faceplate unless indicated otherwise. Provide blank inserts for unoccupied positions.

2.5 FLOOR BOX UTP 4-PAIR MODULAR JACK (VOICE/DATA)

- .1 Refer to Item 2.4 above.

2.6 WORK AREA UTP 4-PAIR MODULAR JACK (RADIO)

- .1 Eight-position modular jack ("RJ-45"), type T568A Category 6 to: TIA/EIA-568-C.2:
 - .1 Mounted in compatible, minimum 4 position, modular, angled, keystone type faceplate, 1-RJ-45 jack positions per faceplate. Provide blank inserts for unoccupied positions.

2.7 TERMINATION AND CROSS-CONNECTION HARDWARE FOR UTP

- .1 IDC Terminal strips, 25 pair, for terminating multi pair 100 Ohm balanced twisted pair cables and supporting cross-connections using jumper wires or compatible plug-ended patch cords: Category 3 to: TIA/EIA-568-C.2.
- .2 Mount block for housing IDC terminal strips on wall in Room 120.
 - .1 Distribution rings or channels capable of externally mating with the above mount for managing cross-connection wires.
- .3 Rack mountable Category 6 patch panels:
 - .1 Modular, keystone type patch panel, 2 rack units high, able to accommodate 48 keystone format ports:
 - .2 Each port equipped with keystone format "RJ-45" jacks, type T568A Category 6 to: TIA/EIA-568-C.2.
 - .3 Horizontal cable-management unit for every 48 ports.
 - .4 Compatible with the telecommunication cabinet.
 - .5 Colour: Black.
 - .6 Provide separate patch panel for radio system.
 - .7 Provide patch panel as required for voice/data system with 25% spare.

2.8 UTP PATCH CORDS

- .1 Category 6 to: TIA/EIA-568-C.2.
- .2 Flame test classification FT6 to: CSA-C22.2 No. 214.
- .3 CSA approved.

- .4 4 pair, stranded, factory assembled with T568A 8P8C (RJ-45) connectors on each end.
- .5 Colour: to be coordinated with Departmental Representative.
- .6 Length and quantity as indicated.
- .7 Unkeyed unless indicated otherwise.

2.9 UTP EQUIPMENT CABLE

- .1 Refer to Item 2.1.
- .2 Colour to be coordinated with Departmental Representative.

2.10 UTP WORK AREA CORDS

- .1 3 metres long, each end equipped with 8P8C "RJ-45" plug Category 6 to: TIA/EIA-568-C.2. Flame test classification FT6 to: CSA-C22.2 No. 214.

2.11 TELECOMMUNICATION CABINET

- .1 Standard TIA enclosed telecommunication cabinet with 44U useable units.
- .2 Welded 14 gauge.
- .3 Dimension: 762 mm wide, 1067 mm depth, 2170 mm high (maximum height).
- .4 Removable side panels.
- .5 Front and rear mounting rails (server type – square holes). Unit supplied with threaded insert for network equipment x 40.
- .6 Preferable door mesh opening (front and rear doors).
- .7 Lockable steel doors (font and rear).
- .8 Bottom cable opening and solid top with cable pass through.
- .9 Complete with integral vertical cable manager on both sides.

- .10 Screw clip inserts.
- .11 PDU monitoring power bar shall be 10 outlets 5-20R with electric code 5-20P.
- .12 Install cabinet in Room 121.
- .13 Approved material: Belden XS Series.

2.12 ANTENNA TO ROOM 121: RADIO CABLE

- .1 Refer to drawing.

PART 3 EXECUTION

3.1 INSTALLATION OF TERMINATION AND CROSS-CONNECT HARDWARE

- .1 Install termination and cross-connect hardware on wall or in rack/cabinet as indicated and according to manufacturers' instructions. Identify and label as indicated to: TIA/EIA-606-A.

3.2 INSTALLATION OF HORIZONTAL DISTRIBUTION CABLES

- .1 Install horizontal cables as indicated in conduits and cable trays from telecommunication rooms to individual work-area jacks. Identify and label as indicated to: TIA/EIA-606-A.
- .2 For Voice and Data terminate three (3) category 6 per outlet unless indicated otherwise.
 - .1 Identify and label as indicated to: TIA/EIA-606-A.
- .3 Terminate one (1) category 6 per outlet unless indicated otherwise.
 - .1 Identify and label as indicated to: TIA/EIA-606-A.
- .4 In areas with floor box, provide excess cable length to accommodate modular furniture outlet termination. Coordinate with modular furniture supplier.

3.3 INSTALLATION OF BACKBONE CABLES

- .1 Install backbone cables from each telecommunications room to main terminal/equipment room (Room 121) as indicated and according to manufacturers' instructions.
 - .1 Identify and label as indicated to: TIA/EIA-606-A.
- .2 Install backbone cables from Room 121 to demarcation point in Entrance Room 120 as indicated and according to manufacturer's instructions.
 - .1 Identify and label as indicated to: TIA/EIA-606-A.

3.4 INSTALLATION OF EQUIPMENT CABLES

- .1 Install equipment cables from equipment patch panel as indicated.
 - .1 Identify and label as indicated to: TIA/EIA-606-A.

3.5 IMPLEMENT CROSS-CONNECTIONS

- .1 Implement cross-connections using patch cords as specified.

3.6 FIELD QUALITY CONTROL

- .1 Test horizontal distribution cable installation in accordance with TIA/EIA 568-A specifications for:
 - .1 Continuity (wiremap) including open/short, polarity, and pair transpositions.
 - .2 Length using TDR.
 - .3 Insertion loss attenuation.
 - .4 NEXT.
 - .5 PS NEXT.
 - .6 ELFEXT.
 - .7 PS ELFEXT.
 - .8 Propagation delay.
 - .9 Delay skew.

.10 Return loss.

.2 Cable Tests:

.1 Copper Testing:

.1 Each pair of each cable installed shall be tested using a "green light" test set that shows opens, shorts, polarity and pair-reversals. Shielded / screened cables shall be tested with a device that verifies shield continuity in addition to the above stated tests. The test shall be recorded as pass/fail as indicated by the test set in accordance with the manufacturers recommended procedures, and referenced to the appropriate cable identification number and circuit or pair number. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.

.2 Each installed cable shall be tested for length using a TDR type device. The cables shall be tested from patch panel to patch panel, block to block, patch panel to outlet or block to outlet as appropriate. The cable length shall conform to the maximum distances set forth in the TIA/EIA-568-A.2 Standard. Cable lengths shall be recorded, referencing the cable identification number and circuit or pair number.

.3 Cable shall be tested for permanent link. Verify the requirements with DIMTPS 3-4.

.4 The test set to be used shall be Level 3 or above. Test sets to have been calibrated within the last 12 months and a copy of the test set "Certificate of Calibration" to be provided to the DIMTPS 3-4 upon request.

.2 Category 6 data cable shall be performance verified using an automated test set. This test set shall be capable of testing for the continuity and length parameters defined above, and provide results for the following tests:

.1 Near End Crosstalk (NEXT).

.2 Attenuation.

.3 Ambient Noise.

.4 Attenuation to Crosstalk Ratio (ACR).

.5 Far End Crosstalk (FEXT).

.3 Test results shall be automatically evaluated by the equipment, using the most up-to-date criteria from the TIA/EIA Standard and the result shown as pass/fail. Test results shall be printed directly from the test unit or from a download file using an application from the test equipment manufacturer. The printed test results shall include all tests performed, the expected test result and the actual test result achieved.

.3 Hardware Tests:

- .1 All hardware shall be tested after installation to ensure that the transmission criterion is met. For connecting hardware with modular interface components (i.e. plug and jack connectors), transmission tests shall performed with both components in a mated state.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 08 71 00 - Door Hardware - General.
- .3 Section 26 05 31 - Splitters, Junction, Pull Boxes and Cabinets.
- .4 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCE DOCUMENTS

- .1 National Fire Protection Association (NFPA)
 - .1 NFPA 70, Article 517, National Electric Code.
 - .2 NFPA 101, Life Safety Code.
- .2 Electronic Industries Association (EIA)
 - .1 REC 12749, Power Supplies.

1.3 REFERENCE STANDARDS

- .1 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S319-05, Electronic Access Control Systems.
 - .2 ULC-ORD-C634-86, Guide for the Investigation of Connectors and Switches for Use with Burglar Alarm Systems.
- .2 Underwriters' Laboratories (UL)
 - .1 UL 294 Revision 3 (2005), Standard for Safety for Access Control System Units.
 - .2 UL 1034-2004, Burglary-Resistant Electric Locking Mechanisms
- .3 Canadian Electrical Code, 2012.
- .4 National Building Code of Canada 2010 (NBCC)

1.4 SUBMITTALS

- .1 Shop Drawings: Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit shop drawings to indicate project layout, including details, conduit routing, door elevation and wiring diagrams.
 - .2 Shop drawing shall be submitted and approved by the Departmental Representative before starting work.
- .2 Operation and Maintenance Manuals: Submit maintenance data for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.
 - .1 Include:
 - .1 System configuration and raceway physical layout.
 - .2 Functional description.
 - .3 Instructions and diagrams.
 - .4 Cleaning instructions.
- .3 As-Built:
 - .1 Submit the as-built drawings to the Departmental Representative in the latest AutoCAD format.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Deposit packaging materials in appropriate container on site for recycling or reuse.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Collect and separate plastic, paper packaging and corrugated cardboard.
- .4 Dispose of corrugated cardboard, polystyrene and plastic packaging material in appropriate on-site bin.

1.6 WARRANTY

- .1 Project Warranty: Refer to Division 1 for project warranty provisions.

- .2 Manufacturer's Warranty: Submit, for Departmental Representative's acceptance, manufacturer's standard warranty document executed by authorized company official.
- .3 Upon Departmental Representative's approval of the installed system, a 1 year warranty on parts will be in effect.

PART 2 PRODUCTS

2.1 RACEWAY SYSTEM

- .1 Provide and install complete systems of raceways, conduit, junction boxes, outlets, cabinets, pull ropes, interconnections, grounding wiring and 120 V power system. Refer to drawing for additional requirement.
- .2 Access control devices and equipment shall be provided and installed by Departmental Representative.

2.2 WIRING

- .1 All wiring shall be FT4 rated and CSA approved.
- .2 Refer to drawing for additional requirements.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalog installation instructions, product carton installation instructions, and datasheet.

3.2 **INSTALLATION: ACCESS CONTROL SYSTEM**

- .1 Install all wiring in conduit. No exposed cable will be accepted.
- .2 Enclose in electrical metal tubing conduit external cables for associated junction box to remaining system locations, from junction box to above ceiling mounted cable ducts or master conduit routes.
- .3 Securely fasten all components to wall, ceiling, or other substrate or structure.
- .4 Install components in accordance with manufacturer's written installation instructions to locations, heights and surfaces shown on reviewed shop drawings.
- .5 Install components secure to walls, ceilings or other substrates.
- .6 Install required boxes in inconspicuous accessible locations.
- .7 Mount conduit and wires, on block wall high enough to not interfere with building operations.
- .8 Main core conduits (53 mm) shall not exceed 9 meters between junction boxes.
- .9 Maximum of two (2) 90 degree bends between any conduit pull points.
- .10 Conceal all conduits in finished areas within walls.
- .11 Where EMT is used in slab, use concrete tight couplings. Do NOT use EMT or aluminum conduit in concrete slab.
- .12 All conduits shall be equipped with approved type expansion joints and clamps whenever conduits cross expansion joints of building.
- .13 Conduit shall be installed at a minimum of 152 mm from heating pipes not insulated and a minimum of 200 mm from all electrical cabling.
- .14 All wall and floor penetrations shall be packed or sealed with an approved fire retardant sealing compound around the conduit.
- .15 All conduits shall be supported independently of the suspended ceiling. Conduits NOT to be anchored to suspended ceiling connection rods.
- .16 Separate conduits shall be provided as indicated on drawing.
- .17 Interconnect pull strings in all junction boxes.

3.3 VERIFICATION

- .1 Perform verification inspections and test in the presence of Departmental Representative.
 - .1 Provide all necessary tools, ladders and equipment.
 - .2 Ensure appropriate subcontractors and security specialists are present for verification.
- .2 Mechanical inspection
 - .1 Departmental Representative and Contractor to tour all areas to insure that all Systems and Subsystems are installed in place for proof of performance testing.
 - .2 Take system inventory at this time. Verify following items before beginning proof of performance tests:
 - .1 All electrical power circuits designated for system equipment are properly labeled, wired, phased, protected and grounded.
 - .2 Conductor ends are protected by heat shrink wrap; audio spade lugs, barrier strips and punch blocks are used.
 - .3 Wiring meets applicable codes and standards.
 - .4 Wiring is complete.
 - .5 Dust, debris, solder splatter, etc. are cleaned and removed from site.
 - .6 All equipment is properly labeled.
 - .7 All equipment identified in System's equipment lists are in-place and properly installed.
 - .8 Each System ground method are installed in accordance with this specification.
- .3 Visual verification: Objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:
 - .1 Sturdiness of equipment fastening.
 - .2 Non-existence of installation related damages.
 - .3 Compliance with reviewed shop drawings.
 - .4 Compatibility of equipment installation with physical environment.
 - .5 Inclusion of all accessories.
 - .6 Device and cabling identification.
- .4 Upon Departmental Representative's approval of the installed system, a 1 year warranty on parts will be in effect.

3.4 LABELLING

- .1 All cables shall be marked with positively fixed durable labels with overlap tab protecting identification from smudging or fading.
- .2 Wire labels should be installed within 200 mm of each cable end but outside the slab outlet points / floor boxes and cross connectors.
- .3 All cable labels and identifiers shall be the same at both ends of a cable. Lettering and numbering shall be black on a white background, longitudinal to cables, shall be typed, at least 4 mm in height, permanent and smudge proof.
- .4 Labels shall have waterproof jackets.
- .5 Hand-written labels are not acceptable.
- .6 Labels: 19.05 mm width x 38.10 mm height x 12.70 mm Printable Height.

3.5 TESTING

- .1 Test all installed cables in accordance with both manufacturer and security cabling standards.

3.6 CLEANING

- .1 Remove protective coverings from accessories and components.
- .2 Adjust all components for correct function.
- .3 Clean housings and system components, free from marks, packing tape, and finger prints, in accordance with manufacturer's written cleaning recommendations.
- .4 Clean all components free from dirt and fingerprints.

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Communication Links.
- .2 Building Intrusion Detection Systems.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 10 - Closeout Submittals.
- .3 Section 26 05 00 - Common Work Results - For Electrical.
- .4 Section 26 05 31 – Splitters, Junction, Pull Boxes and Cabinets.
- .5 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

1.3 REFERENCE DOCUMENTS

- .1 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S302-M91 , Standard for Installation and Classification of Burglar Alarm Systems for Financial and Commercial Premises, Safes and Vaults.
 - .2 CAN/ULC-S303-M91, Standard for Local Burglar Alarm Units and Systems.
 - .3 CAN/ULC-S304-06, Signal Receiving Centre and Premise Burglar Alarm Control Units.
 - .4 ULC-S306-03, Intrusion Detection Units.
 - .5 ULC-S318-96, Power Supplies for Burglar Alarm Systems.
 - .6 ORD-C634, Connectors and Switches for Use with Burglar Alarm Systems.

- .2 Canadian Electrical Code, 2012.
- .3 National Building Code of Canada 2010 (NBCC).

1.4 SUBMITTALS

- .1 Product Data: Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit shop drawing to indicate project layout, including details, conduit routing, door elevation and wiring diagrams.
 - .2 Shop drawing shall be submitted and approved by the Departmental Representative before starting work.
 - .3 Submit the as-built drawings in the Departmental Representative to the latest AutoCAD format.
 - .4 Operation and Maintenance Manuals: Submit Operation and Maintenance Manuals in accordance with Section 01 78 10 - Closeout Submittals.
 - .1 Include:
 - .1 System configuration and raceway physical layout.
 - .2 Functional description.
 - .3 Illustrations and diagrams.
 - .4 Cleaning instructions.

1.5 WARRANTY

- .1 Project Warranty: Refer to Division 1 for project warranty provisions.
- .2 Manufacturer's Warranty: Submit, for Departmental Representative's acceptance, manufacturer's standard warranty document executed by authorized company official.
- .3 Upon Departmental Representative's approval of the installed system, a 1 year warranty on parts will be in effect.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20 - Waste Managing and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused wiring materials from landfill to metal recycling facility as approved by Departmental Representative.

PART 2 PRODUCTS

2.1 RACEWAY SYSTEM

- .1 Provide and install complete systems of raceways, conduit, junction boxes, outlets, cabinets, pull ropes, interconnections, grounding wiring and 120 V power system. Refer to drawing for additional requirements.
- .2 Intrusion alarm devices and equipment shall be provided and installed by Departmental Representative.

2.2 WIRING

- .1 All wiring shall be FT4 rated and CSA approved.
- .2 Refer to drawing for additional requirements.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Comply with manufactures written data, including product technical bulletins, product catalogue installation instructions, product carton installations, and datasheets.

3.2 INSTALLATION

- .1 Coordinate location of systems components with Departmental Representative before installation.
- .2 Cable/wire splices are not permitted.
- .3 Install all wiring in conduit.
- .4 Main core conduits (53 mm) shall not exceed 9 meters between junction boxes.
- .5 Maximum of two (2) 90 degree bends between any conduit pull points.
- .6 Conceal all conduits in finished areas within walls.
- .7 Where EMT is used in slab, use concrete tight couplings. Do NOT use EMT or aluminum conduit in concrete slab.
- .8 All conduits shall be equipped with approved type expansion joints and clamps whenever conduits cross expansion joints of building.
- .9 Conduit shall be installed at a minimum of 152 mm from heating pipes not insulated and a minimum of 200 mm from all electrical cabling.
- .10 All wall and floor penetrations shall be packed or sealed with an approved fire retardant sealing compound around the conduit.
- .11 All conduits shall be supported independently of the suspended ceiling. Conduits NOT to be anchored to suspended ceiling connection rods.
- .12 Separate conduits shall be provided as indicated on drawing.
- .13 Interconnect pull strings in all junction boxes.
- .14 Following the final installation, turn over to Departmental Representative all copies of any site specific data.

3.3 VERIFICATION

- .1 Perform verification inspections and test in the presence of the Departmental Representative.
 - .1 Provide all necessary tools, ladders and equipment.
 - .2 Ensure appropriate subcontractors and manufacturer's representatives are present for verification.
- .2 Conduct visual verification: Objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:
 - .1 Sturdiness of equipment fastening.
 - .2 Non-existence of installation related damages.
 - .3 Compliance of devices locations with reviewed shop drawings.
 - .4 Compliance of equipment installation with physical environment.
 - .5 Raceway and cabling identification.
 - .6 All electrical power circuits designated for system equipment are properly labelled, wired, phased, dedicated and equipped with breaker locking devices.
- .3 Conduct technical verification: Purpose to ensure that all systems and devices are properly installed and free of defects and damages. Technical verification includes:
 - .1 Connecting joints and equipment fastening.
 - .2 Compliance with manufacturer's specification, and approved shop drawing.

3.4 LABELING

- .1 All cables shall be marked with positively fixed durable labels with overlap tab protecting identification from smudging or fading.
- .2 Wire labels should be installed within 200 mm of each cable end but outside the slab outlet points / floor boxes and cross connectors.
- .3 All cable labels and identifiers shall be the same at both ends of a cable. Lettering and numbering shall be black on a white background, longitudinal to cables, shall be typed, at least 4 mm in height, permanent and smudge proof.

- .4 Labels shall have waterproof jackets.
- .5 Hand-written labels are not acceptable.
- .6 Labels: 19.05 mm width x 38.10 mm height x 12.70 mm printable height.

3.5 TESTING

- .1 Test all installed cables in accordance with both manufacturer and security cabling standards.

3.6 CLEANING AND ADJUSTING

- .1 Remove protective covering from control panels, detection devices and components.
- .2 Adjust all components for correct function.
- .3 Clean housing and system components, free from marks, packing materials, and fingerprints, in accordance with manufacturer's written cleaning recommendations.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 78 10 – Closeout Submittals.
- .3 Section 26 05 00 – Common Work Results – For Electrical.
- .4 Section 26 05 31 – Splitters, Junction, Pull Boxes and Cabinets.
- .5 Section 26 05 34 – Conduits, Conduit Fastenings and Conduit Fittings.

1.2 REFERENCE DOCUMENTS

- .1 Electronic Industries Association (EIA).
- .2 Canadian Electrical Code, 2012.
- .3 National Building Code of Canada 2010 (NBCC).

1.3 SUBMITTALS

- .1 Product Data: Submit in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Submit shop drawing to indicate project layout, including details, conduit routing, and wiring diagrams.
- .2 Shop drawing shall be submitted and approved by the Departmental Representative before starting work.
- .3 Submit the as-built drawings in the Departmental Representative to the latest AutoCAD format.
- .4 Operation and Maintenance Manuals: Submit Operation and Maintenance Manuals in accordance with Section 01 78 10 - Closeout Submittals.

- .5 Include:
 - .1 System configuration and raceway physical layout.
 - .2 Functional description.
 - .3 Illustrations and diagrams to supplement procedures.
 - .4 Cleaning instructions.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Deposit packaging materials in appropriate container on site for recycling or reuse.
- .2 Avoid using landfill waste disposal procedures when recycling facilities are available.
- .3 Collect and separate plastic, paper packaging and corrugated cardboard.
- .4 Dispose of corrugated cardboard, polystyrene and plastic packaging material in appropriate on-site bin.

1.5 WARRANTY

- .1 Project Warranty: Refer to Division 1 for project warranty provisions.
- .2 Manufacturer's Warranty: Submit, for Departmental Representative's acceptance, manufacturer's standard warranty document executed by authorized company official.
- .3 Upon Departmental Representative's approval of the installed system, a 1 year warranty on parts will be in effect.

PART 2 PRODUCTS

2.1 RACEWAY SYSTEM

- .1 Provide and install complete systems of raceways, conduit, junction boxes, outlets, cabinets, pull ropes, interconnections, grounding wiring and 120 V power system. Refer to drawing for additional requirements.

- .2 Video surveillance devices and equipment shall be provided and installed by Departmental Representative.

2.2 WIRING

- .1 All wiring shall be FT4 rated and CSA approved.
- .2 Refer to drawing for additional requirements.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Comply with manufactures written data, including product technical bulletins, product catalogue installation instructions, product carton installations, and datasheets.

3.2 INSTALLATION

- .1 Coordinate location of system components with Departmental Representative before installation.
- .2 Install all wiring in conduit.
- .3 Cable/wire splice are not permitted.
- .4 Home run conduit as indicated.
- .5 Install components secure, properly aligned and in locations shown on reviewed shop drawings.
- .6 Main core conduits (53 mm) shall not exceed 9 meters between junction boxes.
- .7 Maximum of two (2) 90 degree bends between any conduit pull points.
- .8 Conceal all conduits in finished areas within walls.

- .9 Where EMT is used in slab, use concrete tight coupling. Do NOT use EMT or aluminum conduit in concrete slab.
- .10 All conduits shall be equipped with approved type expansion joints and clamps whenever conduits cross expansion joints of building.
- .11 Conduit shall be installed at a minimum of 152 mm from heating pipes not insulated and a minimum of 200 mm from all electrical cabling.
- .12 All wall and floor penetrations shall be packed or sealed with an approved fire retardant sealing compound around the conduit.
- .13 All conduits shall be supported independently of the suspended ceiling. Conduits NOT to be anchored to suspended ceiling connection rods.
- .14 Separate conduits shall be provided as indicted on drawings.
- .15 Interconnect pull strings in all junction boxes.

3.3 VERIFICATION

- .1 Perform verification inspections and test in the presence of the Departmental Representative.
 - .1 Provide all necessary tools, ladders and equipment.
 - .2 Ensure appropriate subcontractors and manufacturer's representatives are present for verification.
- .2 Conduct visual verification: Objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:
 - .1 Sturdiness of equipment fastening.
 - .2 Non-existence of installation related damages.
 - .3 Compliance of devices locations with reviewed shop drawings.
 - .4 Compliance of equipment installation with physical environment.
 - .5 Raceway and cabling identification.
 - .6 All electrical power circuits designated for system equipment are properly labelled, wired, phased, dedicated and equipped with breaker locking devices.
- .3 Conduct technical verification: Purpose to ensure that all systems and devices are properly installed and free of defects and damages. Technical verification includes:
 - .1 Connecting joints and equipment fastening.

- .2 Compliance with manufacturer's specification, and approved shop drawing.

3.4 LABELING

- .1 All cables shall be marked with positively fixed durable labels with overlap tab protecting identification from smudging or fading.
- .2 Wire labels should be installed within 200 mm of each cable end but outside the slab outlet points / floor boxes and cross connectors.
- .3 All cable labels and identifiers shall be the same at both ends of a cable. Lettering and numbering shall be black on a white background, longitudinal to cables, shall be typed, at least 4 mm in height, permanent and smudge proof.
- .4 Labels shall have waterproof jackets.
- .5 Hand-written labels are not acceptable.
- .6 Labels: 19.05 mm width x 38.10 mm height x 12.70 mm printable height.

3.5 TESTING

- .1 Test all installed cables in accordance with both manufacturer and security cabling standards.

3.6 CLEANING AND ADJUSTING

- .1 Remove protective covering from accessories and components.
- .2 Adjust all components for correct function.
- .3 Clean housing and system components, free from marks, packing materials, and fingerprints, in accordance with manufacturer's written cleaning recommendations.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common Work Results For Electrical.
- .2 Section 26 05 21 – Wires and Cables (0-1000 V).
- .3 Section 26 41 00.03 – Surge Protection Devices.

1.2 REFERENCES

- .1 Government of Canada
 - .1 National Building Code of Canada.
- .2 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S524, Standard for the Installation of Fire Alarm Systems.
 - .2 CAN/ULC-S525, Audible Signal Appliances For Fire Alarm System.
 - .3 CAN/ULC-S526, Visible Signal Devices for Fire Alarm Systems, Including Accessories.
 - .4 CAN/ULC-S527, Standard for Control Units for Fire Alarm Systems.
 - .5 CAN/ULC-S528, Manual Stations for Fire Alarm Systems, Including Accessories.
 - .6 CAN/ULC-S529, Smoke Detectors for Fire Alarm Systems.
 - .7 CAN/ULC-S536, Inspection and Testing of Fire Alarm Systems.
 - .8 CAN/ULC-S537, Standard for the Verification of Fire Alarm Systems.
- .3 The latest edition of the above standards shall apply.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for multiplex fire alarm system and include product characteristics, performance criteria, physical size, finish and limitations.

- .3 Shop Drawings:
 - .1 Submit drawings in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate on shop drawings:
 - .1 Detail assembly and internal wiring diagrams for control unit and auxiliary cabinets.
 - .2 Overall system riser and wiring diagram identifying control equipment, initiating zones, signaling circuits; identifying terminations, terminal numbers, conductors and raceways.
 - .3 Details for devices.
 - .4 Details and performance specifications for control and peripherals.
 - .5 Battery calculations.
 - .6 Passive graphic layout.
 - .3 Shop drawing submission shall comply with the requirements of the latest version of CAN/ULC-S524, Section 3.5.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for fire alarm system for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.
- .3 Include:
 - .1 Instructions for complete fire alarm system to permit effective operation and maintenance.
 - .2 Technical data - illustrated parts lists with parts catalogue numbers.
 - .3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.
 - .4 List of recommended spare parts for system.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Submit maintenance materials in accordance with Section 01 78 10 - Closeout Submittals.

- .2 Provide for temporary program changes during construction period to include zone labels, control functions and system operation.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging in accordance with Section 01 74 20 - Waste Managing and Disposal.

PART 2 PRODUCTS

2.1 DESCRIPTION

- .1 Fully supervised, microprocessor-based, addressable fire alarm system, utilizing digital techniques for data control and digital, and multiplexing techniques for data transmission.
- .2 System to carry out fire alarm and protection functions; including receiving alarm signals, initiating general alarm, supervising components and wiring, actuating annunciators and auxiliary functions, initiating trouble signals, and signalling to fire department.
- .3 Zoned, non-coded, single stage.
- .4 Modular in design to allow for future expansion.
- .5 Operation of system shall not require personnel with special computer skills.

- .6 System wiring to be Class B circuit configuration for initiating devices and signaling device. All wiring in conduit.
- .7 System to include:
 - .1 Fire Alarm Control Panel (FACP) in separate enclosure with power supply, stand-by batteries, central processor with microprocessor and logic interface, main system memory, input-output interfaces for alarm receiving, annunciation/display, and program control/signalling.
 - .2 Power supplies.
 - .3 Initiating/input circuits.
 - .4 Output circuits.
 - .5 Auxiliary circuits.
 - .6 Wiring.
 - .7 Manual and automatic initiating devices.
 - .8 Audible and visual signalling devices.
 - .9 Event log memory chip.
 - .10 Local display and annunciators.
 - .11 Remote booster power supplies for output circuits.
 - .12 Transponder.
- .8 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.
- .9 Power supply: to CAN/ULC-S524.
- .10 Audible signal devices: to CAN/ULC-S525.
- .11 Visual signal devices: to CAN/ULC-S526.
- .12 Fire alarm control panel: to CAN/ULC-S527.
- .13 Manual pull stations: to CAN/ULC-S528.
- .14 Smoke detectors: to CAN/ULC-S529.
- .15 Heat detectors: to CAN/ULC-S530.
- .16 Regulatory Requirements:
 - .1 System components: listed by ULC and comply with applicable provisions of National Building Code, and meet requirements of local authority having jurisdiction.

2.2 SYSTEM OPERATION: SINGLE STAGE - SIGNALS ONLY

- .1 Actuation of any alarm initiating device to:
 - .1 Cause electronic latch to lock-in alarm state at fire alarm control panel.
 - .2 Indicate zone of alarm at fire alarm control panel and annunciator.
 - .3 Cause audible signalling devices to sound continuously throughout building and at fire alarm control panel.
 - .4 Transmit signal to fire department via fire alarm transponder. (To confirm with Departmental Representative.)
 - .5 Cause AHU to shut down.
- .2 Acknowledging alarm: indicated at fire alarm control panel.
- .3 Ensure that it is possible to silence signals by "alarm silence" switch at fire alarm control panel, after 60 seconds period of operation.
- .4 Subsequent alarm, received after previous alarm has been silenced, to re-activate signals.
- .5 Actuation of supervisory devices to:
 - .1 Cause electronic latch to lock-in supervisory state at fire alarm control panel.
 - .2 Indicate respective supervisory zone at fire alarm control panel and annunciator.
 - .3 Cause audible signal at fire alarm control panel to sound.
 - .4 Activate common supervisory sequence.
- .6 Resetting alarm and supervisory device not to return system indications/functions back to normal until fire alarm control panel has been reset.
- .7 Trouble on system to:
 - .1 Indicate circuit in trouble at fire alarm control panel.
 - .2 Activate "system trouble" indication, buzzer and common trouble sequence. Acknowledging trouble condition to silence audible indication; whereas visual indication to remain until trouble is cleared and system is back to normal.
- .8 Trouble on system: suppressed during course of alarm.
- .9 Trouble condition on any circuit in system not to initiate alarm conditions.

2.3 CONTROL PANEL

- .1 Fire Alarm Control Panel (FACP)
 - .1 Suitable for DCLB communication style: to CAN/ULC-S524.
 - .2 Features specified are minimum requirements for microprocessor-based system with digital data control and digital multiplexing techniques for data transmission.
 - .3 Minimum capacity of 120 addressable monitoring and 120 addressable control/signal points. Points may be divided between 2 communication channels in distributed system, each channel operating independently of other. Faults on one communication channel not to affect operation of other channel.
 - .4 System to provide for priority reporting levels, with fire alarm points assigned highest priority, supervisory and monitoring lower priority, and third priority for troubles. Possible to assign control priorities to control points in system to guarantee operation or allow emergency override as required.
 - .5 Integral power supply, battery charger and standby batteries.
 - .6 Basic life safety software: retained in non volatile Erasable Programmable Read-Only-Memory (EPROM). Extra memory chips: easily field-installed. Random-Access-Memory (RAM) chips in panel to facilitate password-protected field editing of simple software functions (i.e. zone labels, priorities) and changing of system operation software.
 - .7 Circuitry to continuously monitor communications and data processing cycles of microprocessor. Upon failure, audible and visual trouble indication to activate.
 - .8 Support up to 2 RS-232-C I/O ports. FACP output: parallel ASCII with adjustable baud rates to allow interface of any commercially available printer, terminal or PC.
 - .9 Equipped with software routines to provide Event-Initiated-Programs (EIP); change is status of one or more monitor points, may be programmed to operate any or all of system's control points.
 - .10 Software and hardware to maintain time of day, day of week, day of month, month and year.
 - .11 Event recorder via internal memory.
 - .12 Software to operate variable sensitivity addressable smoke detectors and annunciate their status and sensitivity settings at control panel.

2.4 POWER SUPPLIES

- .1 120 V, 60 Hz as primary source of power for system.
- .2 Voltage regulated, current limited distributed system power.
- .3 Primary power failure or power loss (less than 102 V) will activate common trouble sequence.
- .4 Interface with battery charger and battery to provide uninterruptible transfer of power to standby source during primary power failure or loss.
- .5 During normal operating conditions fault in battery charging circuit, short or open in battery leads to activate common trouble sequence and standby power trouble indicator.
- .6 Standby batteries: sealed, maintenance free.
- .7 Continuous supervision of wiring for external initiating and alarm circuits to be maintained during power failure.

2.5 INITIATING/INPUT CIRCUITS

- .1 Receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors, and water flow switches, wired in DCLB configuration to fire alarm control panel.
- .2 Alarm receiving circuits (active and spare): compatible with smoke detectors and open contact devices.
- .3 Actuation of alarm initiating device: cause system to operate as specified in "System Operation".
- .4 Receiving circuits for supervisory, N/O devices. Devices: wired in DCLB configuration to fire alarm control panel.
- .5 Actuation of supervisory initiating device: cause system to operate as specified in "System Operation".
- .6 Circuits shall not be loaded more than 80% of their capacity.

2.6 ALARM OUTPUT CIRCUITS

- .1 Alarm output circuit: connected to signals, wired in class B configuration in separate conduits.
 - .1 Signal circuits' operation to follow system programming; capable of sounding horns continuously at 3-3-3 temporal pattern. Each signal circuit: rated at 2 A, 24 VDC; fuse-protected from overloading/overcurrent.
 - .2 Manual alarm silence, automatic alarm silence and alarm silence inhibit to be provided by system's common control.
 - .3 Circuits shall not be loaded more than 80% of their capacity.

2.7 AUXILIARY CIRCUITS

- .1 Auxiliary contacts for control functions.
- .2 Upon resetting system, auxiliary contacts to return to normal or to operate as pre-programmed.
- .3 Auxiliary circuits: rated at 2 A, 24 VDC or 120 VAC, fuse-protected.

2.8 WIRING

- .1 Solid copper, twisted pair CSA FAS 105, FT-4 cables: rated 300 V.
- .2 Each conductor shall be permanently labelled at both ends.
- .3 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.
- .4 To signal circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.
- .5 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.

2.9 2-HOUR FIRE RATED CABLE (MINERAL-INSULATED CABLE)

- .1 Refer to Section 26 05 21 – Wire and Cables (0-1000 V), Item 2.6.

2.10 MANUAL ALARM STATIONS

- .1 Addressable manual pull station:
 - .1 Pull lever, break glass rod, semi-flush wall mounted type, single action, single stage.
 - .2 Electronics to communicate station's status to addressable module/transponder over 2 wires and to supply power to station.
 - .3 Station address to be set on station in field.
 - .4 Markings on station shall be bilingual.
 - .5 Where vandal resistant pull stations are indicated, device to come complete with clear dome cover constructed of thick, tough polycarbonate material. Cover housing to come with red fire label. Cover to have minimum of three years warranty.

2.11 AUTOMATIC ALARM INITIATING DEVICES

- .1 Addressable Smoke Detectors:
 - .1 Photo-electric type with automatic sensitivity controlled via fire alarm control panel.
 - .2 Electronics to communicate detector's status to addressable module/transponder.
 - .3 Detector address to be set on detector in field.
 - .4 Built-in tamper-resistant feature.
 - .5 Mounting: Smoke detectors to be ceiling mounted.
 - .6 Where vandal resistant smoke detector is indicated, device to come complete with guard ULC-listed for use with smoke detector model and approved by Departmental Representative. Guard to be:
 - .1 Constructed of heavy duty 14 gauge steel.
 - .2 Vandal resistant and tamper proof.
 - .3 Impact resistant.

- .4 All guards / protective cages must be stamped with manufacturer and model number on the face plate.
- .2 Addressable Smoke Detectors in Cells – Rooms 209 & 210:
 - .1 Smoke detector must be compatible and ULC approved for use with guards. Proof of compatibility should be submitted with shop drawings. Smoke detectors to be:
 - .1 Photo electric type with automatic sensitivity controlled via fire alarm control panel.
 - .2 Electronics to communicate detector's status to addressable module/transponder.
 - .3 Detector address to be set on detector in field.
 - .4 Built-in tamper-resistant feature.
 - .2 Guard approved materials:
 - .1 GE Security (Edwards) - Guard model 6255-004.
 - .2 Simplex-Grinnell - Guard model 2098-9829C.
 - .3 Notifier (Honeywell) - Guard model Smoke G1A-2.
 - .4 Vipond – Guard model KSFDG-002 (to protect Notifier (Honeywell) smoke detector model FSL-85).
 - .3 All guards / protective cages must be stamped with manufacturer and model number on the face plate.
- .3 Addressable Air Duct Smoke Detectors:
 - .1 Photo-electric type with automatic sensitivity controlled via fire alarm control panel.
 - .2 Electronics to communicate detector's status to addressable module/transponder.
 - .3 Detector address to be set on detector in field.
 - .4 Photoelectric type addressable smoke detector, as specified above to be in protective detector housing equipped with clear cover, matching twist-lock detector base and air duct sampling tubes.
 - .5 Housing cover to incorporate tamper signal.
- .4 Addressable Heat Detectors:
 - .1 Rate-of-rise type, at minimum of 8 degrees Celsius per minute.
 - .2 Electronics to communicate detector's status to addressable module/transponder.
 - .3 Detector address to be set on detector in field.
 - .4 Built-in tamper-resistant feature.
 - .5 Heat detector to be surface mounted on ceiling.

2.12 AUDIBLE AND VISUAL SIGNAL DEVICES

- .1 Horn:
 - .1 Operating voltage: 24 VDC nominal.
 - .2 Semi-flush on surface, wall mounted type as indicated.
 - .3 Red polycarbonate housing with bilingual FIRE markings.
 - .4 Field selectable high and low sound output.
 - .5 Synchronized operation.
 - .6 Tamper-resistant.
 - .7 Ability to sound signals as specified in "System Operation".
 - .8 Device to be outdoor/weatherproof rated where indicated on drawings.
 - .9 Where device is indicated as vandal resistant, to come complete with guard:
 - .1 Wire guard to be constructed of tough, 9-gauge steel wire, coated with corrosion resistant red polyester.
 - .2 Guard to have minimum three year warranty.
- .2 Strobe:
 - .1 Operating voltage: 24 VDC nominal.
 - .2 Semi-flush on surface, wall mounted type as indicated.
 - .3 Red polycarbonate housing with bilingual FIRE markings.
 - .4 Flashing strobe, clear polycarbonate strobe lens.
 - .5 Candela output: 110 cd, 1 flash per second rate.
 - .6 Synchronized operation.
 - .7 Tamper-resistant.
 - .8 Strobes shall stay ON until reset complete.
 - .9 Strobes to be vandal resistant, coming complete with guard constructed of tough, 9-gauge steel wire, coated with corrosion resistant red polyester. Guard to have minimum three year warranty.

2.13 REMOTE BOOSTER POWER SUPPLIES

- .1 120 V, 60 Hz as primary source of power for system.
- .2 Four Class B notification appliance circuits rated 3 A at 24 VDC: to ULC-S527.
- .3 Configurable signal rates: continuous or 3-3-3 temporal.
- .4 Primary power failure or power loss will activate common trouble sequence.
- .5 Interface with battery to provide uninterruptible transfer of power to standby source during primary power failure or loss.
- .6 During normal operating conditions fault in battery charging circuit, short or open in battery leads to activate common trouble sequence and standby power trouble indicator.
- .7 Standby batteries: rechargeable, sealed, maintenance free, long-life, minimum 5 years life expectancy, guaranteed for 5 years.
- .8 Provide sufficient battery capacity for normal system operation, for not less than 24 hours and immediately following emergency power under full load for not less than 30 minutes. Provide also 25% battery spare capacity.
- .9 Surface mount in CSA Type 2 enclosure with batteries as indicated.

2.14 TRANSPONDER

- .1 Transponder to monitor the status of the control panel and to report alarm, trouble, and supervisory conditions to fire department via monitored telephone lines.
- .2 Power input: 120 VAC.

2.15 REMOTE ANNUNCIATOR PANEL

- .1 Flush mounted complete with flush wallbox and door trim.
- .2 Lockable hinged door with full viewing window.
- .3 Solid state components.

- .4 High intensity LEDs.
- .5 One red LED for each initiation zone, one amber LED for trouble.
- .6 Complete with system reset, lamp test, signal silence, trouble buzzer, trouble silence, and power-on light.
- .7 Modular construction.
- .8 Complete with LCD display module per CAN/ULC-S527.

2.16 END-OF-LINE DEVICE (EOL)

- .1 End-of-line devices to control supervisory current in alarm circuits and signaling circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at the main control panel.

2.17 SPRINKLER MONITORING DEVICES

- .1 Fully addressable input device for each flow switch, tamper switch and pressure switch, etc.

2.18 FAULT ISOLATOR MODULES (LIM)

- .1 Isolator to be a supervised module with two outputs.
- .2 Isolator to incorporate alarm LED, and isolator trouble LEDs.
- .3 Flush mounted, white finish.

2.19 ANCILLARY DEVICES

- .1 Remote relay unit to initiate AHU shutdown.

2.20 SURGE PROTECTION DEVICES

- .1 Surge protection devices in accordance with Section 26 41 00.03 – Surge Protection Devices.

2.21 AS-BUILT RISER DIAGRAM

- .1 Fire alarm system riser diagram: in glazed frame, minimum size 600 x 600 mm.

2.22 ACCEPTABLE MANUFACTURERS

- .1 Acceptable manufacturers:
 - .1 Edwards.
 - .2 Honeywell.
 - .3 Simplex.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for fire alarm installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Departmental Representative.
 - .2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

- .1 Install systems in accordance with CAN/ULC-S524.
- .2 Install fire alarm control panel and connect to dedicated locked breaker in panel as indicated.
- .3 Install manual alarm stations and connect to alarm circuit wiring.
- .4 Locate and install detectors and connect to alarm circuit wiring. Mount detectors more than 1 m from air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts and in accordance with manufacturer's recommendations.
- .5 For smoke detector and guards (vandal-proof application):
 - .1 During installation, use security sealant to fill any space between the back of the mounting plate and the ceiling surface.
 - .2 Surface conduit not approved.
 - .3 Regarding Guard Model 2098-9829C (Simplex):
 - .1 When installing model 2098-9829C, rotate guard so that conduit port is blocked by the perforated tab on the mounting plate.
 - .2 Guard model 2098-9829C must be used in air velocities greater than 3 meters per minute as a condition of ULC approval.
 - .3 Consult manufacturer instructions before installation.
 - .4 Regarding Guard Model 6255-004 (Edwards):
 - .1 When installing model 6255-004, rotate conduit entrance cover 90 degrees to ensure no opening exists when installed.
 - .2 Guard model 6255-004 must be used in air velocities greater than 9 meters per minute as a condition of ULC approval.
 - .3 Consult manufacturer for additional installation instructions.
 - .5 Regarding Guard Model Smoke G1A-2 (Honeywell) and KSFDG-002 (Vipond):
 - .1 Consult manufacturer instructions before installation.
- .6 Connect alarm circuits to fire alarm control panel.
- .7 Install signal horns and visual signal devices and connect to signalling circuits.
- .8 Connect signalling circuits to fire alarm control panel.
- .9 Install remote relay units to control fan shut down.

- .10 Sprinkler system: wire alarm and supervisory switches and connect to control panel.
- .11 Splices are not permitted.
- .12 Provide necessary raceways, cable and wiring to make interconnections to terminal boxes, annunciator equipment and FACP, as required by equipment manufacturer.
- .13 Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.
- .14 Identify circuits and other related wiring at FACP, annunciators, and terminal boxes.
- .15 All fault isolating modules shall be visible and accessible. They shall not to be installed above the ceiling tiles.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and CAN/ULC-S537.
- .2 Fire alarm system:
 - .1 Test such device and alarm circuit to ensure manual stations, heat detectors, smoke detectors and sprinkler system transmit alarm to control panel and actuate general alarm.
 - .2 Check annunciator panels to ensure zones are shown correctly.
 - .3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of systems.
 - .4 Addressable circuits system style DCLB:
 - .1 Test each conductor on all DCLB addressable links for capability of providing 3 or more subsequent alarm signals on each side of single open-circuit fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.

- .2 Test each conductor on all DCLB addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
- .3 Provide certificate to Departmental Representative. Show the CFAA registration number for the technicians.
- .4 Provide final PROM program re-burn for Departmental Representative incorporating program changes made during construction.
- .5 Fire alarm system verification shall be carried out by CFAA registered fire alarm technicians.
- .6 The AHJ shall perform a spot inspection and acceptance tests prior to substantial completion and occupancy of the building. Any faults/deficiencies found during the inspection shall be rectified prior to granting occupancy.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 – Cleaning and Waste Processing.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion and verification of performance installation remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Processing.
- .3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Waste Managing and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
 - .2 Place materials defined as hazardous or toxic waste in designated containers.
 - .3 Ensure empty containers are sealed and stored safely for disposal.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by fire alarm system installation.

3.6 CLOSEOUT ACTIVITIES

- .1 Provide on-site lectures and demonstration and software by fire alarm equipment manufacturer to train operational personnel in use, programming and maintenance of fire alarm system.

3.7 MAINTENANCE

- .1 Provide one year's free maintenance with two inspections by manufacturer during warranty period. Inspection tests to conform to CAN/ULC-S536. Submit inspection report to Departmental Representative.
- .2 Include ten (10) spare glass rods for manual pull box stations.
- .3 Provide to the Departmental Representative, all interconnect hardware, software, programming tools, and documentation necessary for the Departmental Representative to modify the system on site. Modifications shall include the addition of devices, circuits, zones and changes to the system operation and custom label changes for devices, circuits or zones. The structure and software shall not place any limit on the type or extent of software modifications on site. Modifications of software shall not require powerdown of the system or loss of system fire protection while modifications are being made. It shall be possible to execute all program modifications are being made. It shall be possible to execute all program modifications without the use of a laptop computer.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 00 - Common works Results - for Electrical.
- .2 Section 26 05 21 - Wires and Cables (0-1000 V).
- .3 Section 26 05 34 - Conduits, conduit Fastenings and Conduit Fittings.

1.2 REFERENCES

- .1 National Institute for Occupational Safety and Health (NIOSH).
 - .1 NIOSH Pocket Guide to Chemical Hazards.

1.3 SYSTEM DESCRIPTION

- .1 System to include:
 - .1 Field programmable control panel with LCD display, LED alarm indication, audible alarm, 4-20mA analog inputs for gas sensors, and relay outputs.
 - .2 Gas sensors: Carbon Monoxide (CO) and Nitrogen Dioxide (NO₂) sensors complete with analog transmitters to transmit 4-20 mA output linear to the concentration of the target gas.
 - .3 Wiring.
 - .4 Connections to exhaust fan motor starter in Room 201.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - submittal Procedures.
- .2 Include:
 - .1 Detail assembly and internal wiring diagrams for control units and transmitters.
 - .2 Overall system diagram.

- .3 Details and performance specifications for control panel, transmitters, gas sensors and strobe/horn with item by item cross reference to specifications for compliance.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for gas detection system for incorporation into manual specified in Section 01 78 10 - Closeout Submittals.
- .2 Include:
 - .1 Instructions for complete gas detection system to permit effective operation and maintenance.
 - .2 Technical data - illustrated parts lists with parts catalogue numbers.
 - .3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.
 - .4 List of recommended spare parts for system.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20 - Waste Managing and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard and packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Departmental Representative.
- .5 Divert unused batteries from landfill to local battery recycling facility approved by Departmental Representative.
- .6 Fold up metal banding, flatten and place in designated area for recycling.

1.7 MAINTENANCE

- .1 Provide one year free maintenance with inspections and sensor calibration as required by manufacturer during warranty period. Submit inspection reports to Departmental Representative.

1.8 EXTRA MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 10 - Closeout Submittals.

1.9 TRAINING

- .1 Provide on-site lectures and demonstration by gas detection system equipment manufacturer to train operational personnel in the use and maintenance of gas detection system.
- .2 Provide two, two hours each, sessions. The actual dates of sessions to be coordinated with Departmental Representative.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Gas detection control panel:
 - .1 Wall mount, self-contained, field programmable control panel with digital display, LED alarm indication, and door mounted audible alarm with silence/acknowledge switch.
 - .2 Scrolling LCD display of gas, concentration, and alarm status.
 - .3 Capable of supporting up to eight (8) analog transmitters.
 - .4 Three programmable alarm levels: low, mid and high.
 - .5 Eight (8) form C output relays rated 5 A, 120 VAC.
 - .6 24 VDC regulated power output for transmitters.
 - .7 Operating voltage 120 VAC, 60 Hz.

- .8 Enclosure CSA Type 2 rated.
- .2 Strobe/horn:
 - .1 Electronic, 90 dB at 3 m with adjustable sound.
 - .2 Voltage to operate from the gas detection panel.
 - .3 115 strobe candela.
 - .4 Wall mounted c/w vandal resistant wire guard.
 - .5 Coordinate labeling and strobe colour with Departmental Representative.
 - .6 ULC listed.
- .3 Gas sensors:
 - .1 Carbon Monoxide (CO) and nitrogen dioxide (NO₂) sensors complete with transmitter to operate at 24 VDC supplied by control panel and to produce a linear, analog signal of 4-20 mA representing a sensor range of 0 to 100% LEL.
 - .2 Complete with vandal resistant wire guard for sensor.
 - .3 End of life warning.
 - .4 Coverage area 696 m².
- .4 Wiring:
 - .1 To analog transmitters (4-20 mA signal): #16 AWG minimum, twisted, shielded, and in accordance with manufacturer's requirements.
 - .2 To analog transmitters (24 VDC power): #16 AWG minimum, shielded, and in accordance with manufacturer's requirements.
 - .3 To control circuits: #12 AWG minimum, shielded, and in accordance with manufacturer's requirements.

2.2 SYSTEM OPERATION

- .1 Upon detection of 25 ppm Carbon-Monoxide and 0.7 ppm NO₂ in any of the detection zones, the system shall:
 - .1 Illuminate the "Alarm" LED.
 - .2 Send signal to exhaust fan motor starter to start the fan.
 - .3 Activate strobe/horn.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install system as indicated and in accordance with manufacturer's recommendations.
- .2 Install all wiring in conduit.
- .3 Conceal all conduit in Room 201 and 203.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - for Electrical.
- .2 Engage the authorized manufacturer's representative to perform inspection and verification of the gas detection system and bear the cost of such inspection. Provide written verification report.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-in-Place Concrete.
- .2 Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .3 Section 32 11 16.01 - Granular Sub-Base.
- .4 Section 32 11 23 - Granular Base.
- .5 Section 33 41 00 - Storm Utility Drainage Piping.

1.2 REFERENCES

- .1 ASTM international
 - .1 ASTM D 4791-10, Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Samples:
 - .1 Allow continual sampling by Departmental Representative during production, as requested.
 - .2 Provide Departmental Representative with access to source and processed material for sampling.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions
- .2 Transportation and Handling: handle and transport aggregates to avoid segregation, contamination and degradation.
- .3 Storage: store washed materials or materials excavated from underwater 24 hours minimum to allow free water to drain and for materials to attain uniform water content.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, free from adherent coatings and injurious amounts of disintegrated pieces or other deleterious substances.
- .2 Flat and elongated particles of coarse aggregate: to ASTM D 4791.
 - .1 Greatest dimension to exceed 5 times least dimension.
- .3 Fine aggregates satisfying requirements of applicable section to be one, or blend of following:
 - .1 Natural sand
 - .2 Manufactured sand
 - .3 Screenings produced in crushing of quarried rock, boulders, gravel or slab
- .4 Coarse aggregates satisfying requirements of applicable section to be one of or blend of following:
 - .1 Crushed rock.

2.2 SOURCE QUALITY CONTROL

- .1 Inform Departmental Representative of proposed source of aggregates and provide access for sampling 4 weeks minimum before starting production.
- .2 Provide all necessary laboratory test data including chemical properties of aggregates to demonstrate that aggregate materials meet the specified requirements of this and all related sections.
- .3 If materials from proposed source do not meet, or cannot reasonably be processed to meet, specified requirements, locate alternative source.
- .4 Advise Departmental Representative 4 weeks minimum in advance of proposed change of material source.
- .5 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Processing:
 - .1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation
 - .2 Blend aggregates, as required, including reclaimed materials that meet physical requirements of specification is permitted in order to satisfy gradation requirements for material and, percentage of crushed particles, or particle shapes specified.
 - .1 Use methods and equipment approved in writing by Departmental Representative.
- .2 When operating in stratified deposits use excavation equipment and methods that produce uniform, homogeneous aggregate gradation.
- .3 Where necessary, screen, crush, wash, classify and process aggregates with suitable equipment to meet requirements.
 - .1 Use only equipment approved in writing by Departmental Representative.

- .4 Stockpiling:
 - .1 Stockpile aggregates on site in locations as directed otherwise by Departmental Representative. Do not stockpile on completed pavement surfaces.
 - .2 Stockpile aggregates in sufficient quantities to meet project schedules
 - .3 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.
 - .4 Except where stockpiled on acceptably stabilized areas, provide compacted sand base not less than 300 mm in depth to prevent contamination of aggregate. Stockpile aggregates on ground but do not incorporate bottom 300 mm of pile into Work.
 - .5 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.
 - .6 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Departmental Representative within 48 hours of rejection.
 - .7 Stockpile materials in uniform layers of thickness as follows:
 - .1 Maximum 1.5 m for coarse aggregate and base course materials.
 - .2 Maximum 1.5 m for fine aggregate and sub-base materials.
 - .3 Maximum 1.5 m for other materials.
 - .8 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.
 - .9 Do not cone piles or spill material over edges of piles.
 - .10 Do not use conveying stackers.
 - .11 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile

3.2 CLEANING

- .1 Progress Cleaning: Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 31 22 13 – Rough Grading.

1.2 DEFINITIONS

- .1 Clearing consists of cutting off trees and brush vegetative growth to not more than specified height above ground and disposing of felled trees, previously uprooted trees and stumps, and surface debris.
- .2 Grubbing consists of excavation and disposal of stumps and roots boulders and rock fragments of specified size to not less than specified depth below existing ground surface.

1.3 QUALITY ASSURANCE

- .1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.4 STORAGE AND PROTECTION

- .1 Prevent damage to fencing trees landscaping natural features bench marks existing buildings utility lines site appurtenances water courses which are to remain.
 - .1 Repair damaged items to approval of Departmental Representative.
 - .2 Replace trees designated to remain, if damaged, as directed by Departmental Representative.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 All cleared and grubbed materials are to be disposed of offsite.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Soil Material for Fill:
 - .1 Excavated soil material: free of debris, roots, wood, scrap material, vegetable matter, refuse, soft unsound particles, deleterious, or objectionable materials.
 - .2 Remove and store soil material for reuse.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Inspect site and verify with Departmental Representative, items designated to remain.
- .2 Locate and protect utility lines: preserve in operating condition active utilities traversing site.
 - .1 Notify Departmental Representative immediately of damage to or when unknown existing utility lines are encountered.
- .3 Notify utility authorities before starting clearing and grubbing.
- .4 Keep roads and walks free of dirt and debris.

3.2 CLEARING

- .1 Clear as indicated by Departmental Representative, by cutting at height of not more than 300 mm above ground. In areas to be subsequently grubbed, height of stumps left from clearing operations to be not more than 1000 mm above ground surface.
- .2 Cut off branches and cut down trees overhanging area cleared as directed by Departmental Representative.

- .3 Cut off unsound branches on trees designated to remain as directed by Departmental Representative.

3.3 ISOLATED TREES

- .1 Cut off isolated trees as indicated by Departmental Representative at height of not more than 300 mm above ground surface.
- .2 Grub out isolated tree stumps.

3.4 GRUBBING

- .1 Remove and dispose of roots larger than 7.5 cm in diameter, matted roots, and designated stumps from indicated grubbing areas.
- .2 Grub out stumps and roots to not less than 200 mm below ground surface.
- .3 Grub out visible rock fragments and boulders, greater than 300 mm in greatest dimension, but less than 0.25 mm.
- .4 Fill depressions made by grubbing with suitable material and to make new surface conform with existing adjacent surface of ground.

3.5 REMOVAL AND DISPOSAL

- .1 Remove cleared and grubbed materials off site to disposal area.

3.6 FINISHED SURFACE

- .1 Leave ground surface in condition suitable for immediate grading operations and stripping of topsoil to approval of Departmental Representative.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

PART 1 GENERAL

1.1 RELATED REQUIRMENTS

- .1 Section 31 23 33.01 – Excavating, Trenching and Backfilling.

1.2 REFERENCES

- .1 ASTM International.
 - .1 ASTM D 698-12E1, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600 kN-m/m³)

1.3 EXISTING CONDITIONS

- .1 Examine subsurface investigation report which is bound into specification.
- .2 Known underground and surface utility lines and buried objects are as indicated on site plan. Contractor to confirm locations on site prior to commencing work.

1.4 PROTECTION

- .1 Protect existing trees, natural features, survey markers, pavement, surface and/or underground utilities which are to remain. If damaged, restore to original condition unless directed otherwise by Departmental Representative.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Fill material: Select Backfill Material in accordance with of Section 31 23 33.01 - Excavating, Trenching and Backfilling.

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

- .1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected.
- .2 Commence topsoil stripping of areas as indicated after area has been cleared of brush weeds and grasses and removed from site.
- .3 Strip topsoil to depths as indicated. Rototill weeds and grasses and retain as topsoil on site. Avoid mixing topsoil with subsoil.
- .4 Stockpile in locations as directed by Departmental Representative. Stockpile height not to exceed 2 m.
- .5 Dispose of unused topsoil off site.

3.2 GRADING

- .1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.
- .2 Rough grade to depths as indicated below finish grades for landscaped areas and graveled access.
- .3 Slope rough grade away from building as indicated.
- .4 Grade ditches to depth as indicated.
- .5 Prior to placing fill over existing ground, scarify surface to depth of 150 mm minimum before placing fill over existing ground. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.
- .6 If encountered, remove soft, weak or loose material from rough grade including those that extend below required elevations to extent and depth as directed by Departmental Representative.
 - .1 Replace excavated material as described elsewhere in this section.
- .7 Compact filled and disturbed areas with Select Backfill Material maximum dry density to ASTM D 698, as follows:
 - .1 95% under landscaped areas.

- .2 98% under exterior asphalt and concrete areas.
- .8 Do not disturb soil within branch spread of trees or shrubs to remain.

3.3 CLEANING

- .1 Progress Cleaning: Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.4 PROTECTION

- .1 Maintain access roads to prevent accumulation of construction related debris on roads.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 03 30 00 - Cast-in-Place Concrete.
- .3 Section 31 05 16 - Aggregate Materials.
- .4 Section 31 22 13 - Rough Grading.
- .5 Section 31 32 19.01 – Geotextiles.

1.2 REFERENCES

- .1 American Society for Testing and Materials International (ASTM).
 - .1 ASTM C 117-13, Standard Test Method for Material Finer than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D 422-63(2007)e1, Standard Test Method for Particle-Size Analysis of Soils.
 - .4 ASTM D 698-12E1, Standard Test Methods for Laboratory Compaction Characteristics of soil using Standard Effort (12,400 ft-lb/ft³)(600kN-m/m³).
 - .5 ASTM D 4318-10e1, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB).
 - .1 .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Nova Scotia Transportation and Infrastructure Renewal (NSTIR)
 - .1 Standard Specification for Highway Construction and Maintenance (latest edition).

1.3 DEFINITIONS

- .1 Excavation classes: two classes of excavation will be recognized; common excavation and rock excavation.
 - .1 Rock: solid material in excess of 1.00 m³ and which cannot be removed by means of heavy duty mechanical excavating equipment. Frozen material not classified as rock
 - .2 Common excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation
- .2 Topsoil:
 - .1 Material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.
 - .2 Material reasonably free from subsoil, clay lumps, brush, objectionable weeds, and other litter, and free from cobbles, stumps, roots, and other objectionable material larger than 25 millimeters in any dimension.
- .3 Waste material: excavated material unsuitable for use in Work or surplus to requirements.
- .4 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of Work.
- .5 Recycled fill material: material, considered inert, obtained from alternate sources and engineered to meet requirements of fill areas.
- .6 Unsuitable materials:
 - .1 Weak, chemically unstable, and compressible materials:
 - .2 Frost susceptible materials:
 - .1 Fine grained soils with plasticity index less than 10 when tested to ASTM D 4318, and gradation within limits specified when tested to ASTM D 422 and ASTM C 136: Sieve sizes to CAN/CGSB-8.2.
 - .2 Table:

Sieve Designation	% Passing
2.00 mm	100
0.10 mm	45-100
0.02 mm	10-80
<u>0.005 mm</u>	<u>0-45</u>
 - .3 Coarse grained soils containing more than 20 % by mass passing 0.075 mm sieve.

- .7 Unshrinkable fill: very weak mixture of cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated.

1.4 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Preconstruction Submittals:
 - .1 Submit to Departmental Representative for review and approval copies of laboratory test data for physical properties and performance criteria of various materials described herein.
- .3 Samples:
 - .1 Submit samples when requested in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of materials and provide access for sampling.

1.5 QUALITY ASSURANCE

- .1 Submit design and supporting data at least 2 weeks prior to beginning Work.
- .2 Keep design and supporting data on site.
- .3 Engage services of qualified professional Engineer who is registered or licensed in Nova Scotia to design and inspect cofferdams, shoring, bracing and underpinning required for Work.
- .4 Health and Safety Requirements:
 - .1 Do construction occupational health and safety in accordance with Section 01 35 23 - Health and Safety.

1.6 EXISTING CONDITIONS

- .1 Examine subsurface investigation report which is bound into specification.
- .2 Buried Services:
 - .1 Maintain copies of the approved clearance to dig permit and associated drawings on site during the work. Ensure all workers, trades and sub-contractors are aware of existing utilities.
 - .2 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.
 - .3 Confirm locations of buried utilities by careful test excavation methods.
 - .4 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered as indicated.
 - .5 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing re-routing or otherwise disturbing utilities or structures. Pay Costs for such work.
 - .6 Record location of maintained, re-routed and abandoned underground lines.
 - .7 Confirm locations of recent excavations adjacent to area of excavation.
- .3 Existing buildings and surface features:
 - .1 Conduct, with Departmental Representative, condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, rail tracks, pavement, survey bench marks and monuments which may be affected by Work.
 - .2 Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately make repair as directed by Departmental Representative.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 All granular materials shall be non-ore bearing.
- .2 Type 1 granular material: Type 1 gravel in accordance with NSTIR's Standard Specifications for Highway Construction and Maintenance.
- .3 Type 2 granular material: Type 2 gravel material in accordance with NSTIR's Standard Specifications for Highway Construction and Maintenance.

- .4 Foundation Backfill: Type 1 or Type 2 granulars.
- .5 Backfill material: selected material approved by Departmental Representative for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.
- .6 Type C3 free-draining material: Type C3 crushed clear stone in accordance with NSTIR's Standard Specifications for Highway Construction and Maintenance.
- .7 Type C5 foundation drain clear stone: Type C5 crushed clear stone in accordance with NSTIR's Standard Specifications for Highway Construction and Maintenance.
- .8 Surge Fill: well-graded granular material, maximum particle size not to be exceed 100 mm and fines content not to exceed 5%.

PART 3 EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

3.2 SITE PREPARATION

- .1 Notify Departmental Representative 24 hours in advance of any excavation, trenching or backfilling activity.
- .2 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

3.3 PREPARATION/ PROTECTION

- .1 Keep excavations clean, free of standing water, and loose soil.
- .2 Where soil is subject to significant volume change due to change in moisture content, cover and protect to satisfaction of Departmental Representative.

- .3 Protect natural and man-made features required to remain undisturbed. Unless otherwise indicated or located in an area to be occupied by new construction, protect existing trees from damage.
- .4 Protect buried services that are required to remain undisturbed.
- .5 Implement sufficient erosion and sediment control measures to prevent sediment release off construction boundaries and into water bodies.

3.4 STRIPPING OF TOPSOIL

- .1 Strip topsoil in accordance with Section 31 22 13 - Rough Grading.

3.5 STOCKPILING

- .1 Stockpile fill materials in areas designated by Departmental Representative.
 - .1 Stockpile granular materials in manner to prevent segregation.
- .2 Protect fill materials from contamination.

3.6 DEWATERING

- .1 Keep excavations free of water while Work is in progress.
- .2 Provide for Departmental Representative's review approval details of proposed dewatering or heave prevention methods, including dikes, well points, and sheet pile cut-offs.
- .3 Protect open excavations against flooding and damage due to surface run-off.
- .4 Dispose of water in accordance with applicable federal, municipal and provincial regulations and in manner not detrimental to public and private property, or portion of Work completed or under construction.
 - .1 Provide and maintain temporary drainage ditches and other diversions outside of excavation limits.
- .5 Provide flocculation tanks, settling basins, or other treatment facilities to remove suspended solids or other materials before discharging to storm sewers, watercourses or drainage areas.

3.7 EXCAVATION

- .1 Maintain sides and slopes of excavations in safe condition by appropriate methods and in accordance with Health and Safety Act for the Province of Nova Scotia.
- .2 Excavate to lines, grades, elevations and dimensions as indicated.
- .3 Remove concrete, masonry, paving, walks, demolished foundations and rubble and other obstructions encountered during excavation.
- .4 Excavation must not interfere with bearing capacity and normal 1:1 (H:V) splay of adjacent foundations.
- .5 Do not disturb soil within branch spread of trees or shrubs that are to remain.
- .6 For trench excavation, unless otherwise authorized by Departmental Representative in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.
- .7 Keep excavated and stockpiled materials safe distance away from edge of trench, such that the materials do not fall within 1:1 (H:V) splay upward from trench bottom.
- .8 Restrict vehicle operations directly adjacent to open trenches.
- .9 Dispose of surplus and unsuitable excavated material offsite in accordance with applicable federal, municipal and provincial regulations.
- .10 Do not obstruct flow of surface drainage or natural watercourses.
- .11 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.
 - .1 In areas of foundations, re-compact earth bottom of excavation with large diesel plate tamper or small 5 tonne vibratory steel drum roller.
- .12 Obtain Departmental Representative approval of completed excavation.
- .13 If encountered remove unsuitable material from trench bottom including those that extend below required elevations to extent and depth as directed by Departmental Representative.
- .14 Dig minimum of 5 test excavations at boundary corners and center of area depicted on drawing 100 to a minimum depth of 3.5m to identify lateral and vertical extent of any unsuitable material. Excavations to be conducted in the presence of Departmental Representative. Refer to geotechnical report for additional information.

- .15 Replacement of unsuitable material, build-up of subgrade to desired elevation, and correction of unauthorized over-excavation to be as follows and to satisfaction of Departmental Representative:
 - .1 Fill under bearing surfaces and footings with Engineered Fill compacted to not less than 100% of Standard Proctor maximum dry density.
 - .2 Fill under other areas with Select Backfill Material compacted to not less than 95% of Standard Proctor maximum dry density.
- .16 Hand trim, make firm and remove loose material and debris from excavations.
 - .1 Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.
- .17 Install any geotextiles in accordance with Section 31 32 19.01 – Geotextiles

3.8 BACKFILL TYPES AND COMPACTION

- .1 Use types of backfill as indicated and specified below. Compaction densities are percentages of maximum densities obtained from ASTM D 698.
 - .1 Exterior side of perimeter walls: use Type 1 Backfill to subgrade level. Compact to 95% of maximum dry density, unless noted otherwise.
 - .2 Within building area: use 25 mm Crushed Rock Base directly beneath floor slabs. Compact to 100% of maximum dry density
 - .3 Under concrete footings: use Engineered Fill as required directly beneath footing. Compact to 100% of maximum dry density.
 - .4 Within landscaped area: use Select Backfill Material to finished grade level. Compact to 95% of maximum dry density.
 - .5 Under exterior concrete or asphalt surfaces: use Engineered Fill or Select Backfill Material to subgrade level. Compact to 95% of maximum dry density to 300mm below subgrade and to 98% of maximum dry density within 300mm of subgrade.

3.9 BEDDING AND SURROUND OF UNDERGROUND SERVICES

- .1 Place and compact material for bedding and surround of underground services as indicated and as specified in other sections.
- .2 Place bedding and surround material in unfrozen condition

3.10 BACKFILLING

- .1 Vibratory compaction equipment: as required to achieve specified compaction throughout layer. Lighter equipment to be used immediately adjacent structures.
- .2 Do not proceed with backfilling operations until completion of following:
 - .1 Departmental Representatives has inspected and approved installation.
 - .2 Departmental Representative has inspected and approved of construction below finish grade.
 - .3 Inspection, testing, approval, and recording location of underground utilities.
 - .4 Removal of concrete formwork.
- .3 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.
- .4 Do not use backfill material which is frozen or contains ice, snow, or debris.
- .5 Place backfill material in uniform layers not exceeding 200 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer. Thinner layers will be required where light compaction equipment is required.
- .6 Backfilling around installations:
 - .1 Place bedding and surround material as specified elsewhere in this section.
 - .2 Do not backfill around or over cast-in-place concrete within 24 hours after placing of concrete.
 - .3 Place layers simultaneously on both sides of installed Work to equalize loading.

3.11 RESTORATION

- .1 Upon completion of Work, remove waste materials and debris. Trim slopes, and correct defects as directed by Departmental Representative.
- .2 Replace topsoil and landscaping as indicated and to satisfaction of Departmental Representative.
- .3 Clean and reinstate areas affected by Work to Departmental Representative's satisfaction.

- .4 Protect newly graded areas from traffic and erosion and maintain free of trash or debris.

PART 1 GENERAL

1.1 MEASUREMENT PROCEDURES

- .1 Included in lump sum contract.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM D 4491-00a(2014)e1, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
 - .2 ASTM D 4595-11, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
 - .3 ASTM D 4716-14, Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
 - .4 ASTM D 4751-12, Standard Test Method for Determining Apparent Opening Size of a Geotextile.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-4.2 No. 11.2-M89(April 1997), Textile Test Methods - Bursting Strength - Ball Burst Test (Extension of September 1989).
 - .2 CAN/CGSB-148.1, Methods of Testing Geotextiles and Complete Geomembranes.
 - .1 No.2-M85, Methods of Testing Geosynthetics - Mass per Unit Area.
 - .2 No.3-M85, Methods of Testing Geosynthetics - Thickness of Geotextiles.
 - .3 No.6.1-93, Methods of Testing Geotextiles and Geomembranes - Bursting Strength of Geotextiles Under No Compressive Load.
 - .4 No.7.3-92, Methods of Testing Geotextiles and Geomembranes - Grab Tensile Test for Geotextiles.
 - .5 No. 10-94, Methods of Testing Geosynthetics - Geotextiles - Filtration Opening Size.

- .3 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-G40.20/G40.21-04, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to Departmental Representative following samples at least 4 weeks prior to beginning Work.
 - .1 Minimum length of 2 m of roll width of geotextile.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 During delivery and storage, protect geotextiles from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and/or recycling in accordance with Section 01 74 00 - Waste Managing And Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.1 MATERIAL

- .1 Geotextile: non-woven synthetic fibre fabric, supplied in rolls. Composed of: minimum 85% by mass of polypropylene or polyester with inhibitors added to base plastic to resist deterioration by ultra-violet and heat exposure.
- .2 Physical properties:
 - .1 Mass per unit area: to CAN/CGSB-148.1, No.2, minimum 50 g/m².
- .3 Hydraulic properties:
 - .1 Filtration opening size (FOS): maximum of 700 micrometers
 - .2 Permeability: minimum permeability of 0.001 m/s.
- .4 Factory seams: sewn in accordance with manufacturer's recommendations.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Place geotextile material by unrolling onto graded surface in orientation, manner and locations indicated and retain in position with small piles of imported meter material.
- .2 Place geotextile material smooth and free of tension stress, folds, wrinkles and creases.
- .3 Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.
- .4 Overlap each successive strip of geotextile 600 mm over previously laid strip.
- .5 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.
- .6 Replace damaged or deteriorated geotextile to approval of Departmental Representative.

- .7 Place overlying layer of imported filter material in accordance with Section 33 36
33 – Utility Drainage Field.

3.2 CLEANING

- .1 Remove construction debris from Project site and dispose of debris in an
environmentally responsible and legal manner.

3.3 PROTECTION

- .1 Vehicular traffic not permitted directly on geotextile.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 31 05 16 - Aggregate Materials.

1.2 REFERENCES

- .1 ASTM International.
 - .1 ASTM C 117-13, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 131-06, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .3 ASTM C 136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM D 422-63(2007), Standard Test Method for Particle-Size Analysis of Soils.
 - .5 ASTM D 698-12E1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort ((12 400 ft-lbf/ft³ (600 kN-m/m³)).
 - .6 ASTM D 1883-07e2, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Nova Scotia Transportation and Infrastructure Renewal (NSTIR).
 - .1 Standard Specification for Highway Construction and maintenance (latest edition).

1.3 SAMPLE PANELS AREAS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Storage and Handling Requirements:
 - .1 Store materials in accordance with erosion and sedimentation control plan and Section 31 05 16 - Aggregate Materials.
 - .2 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Type 2 material, to Division 3, Section 2 of the NSTIR Standard Specification for Highway Construction and Maintenance.

PART 3 EXECUTION

3.1 PLACING

- .1 Place granular sub-base after subgrade is inspected and approved by Departmental Representative.
- .2 Construct granular sub-base to depth and grade in areas indicated.
- .3 Ensure no frozen material is placed.
- .4 Place material only on clean unfrozen surface, free from snow or ice.
- .5 Begin spreading sub-base material on crown line or high side of one-way slope.
- .6 Place granular sub-base materials using methods which do not lead to segregation or degradation.
- .7 Place material to full width in uniform layers not exceeding 200 mm compacted thickness.
 - .1 Departmental Representative may authorize thicker lifts if specified compaction can be achieved.

- .8 Shape each later to smooth contour and compact to specified density before succeeding layer is placed.
- .9 Remove and replace portion of layer in which material has become segregated during spreading.

3.2 COMPACTION

- .1 Compaction equipment to be capable of obtaining required material densities.
- .2 Compact to density of not less than 100% maximum dry density in accordance with ASTM D 698.
- .3 Shape and roll alternately to obtain smooth, even and uniformly compacted sub-base.
- .4 Apply water as necessary during compaction to obtain specified density.
- .5 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved by Departmental Representative.
- .6 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.3 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.4 SITE TOLERANCES

- .1 Finished sub-base surface to be within 10 mm of elevation as indicated but not uniformly high or low.

3.5 PROTECTION

- .1 Maintain finished sub-base in condition conforming to this section until succeeding base is constructed, or until granular sub-base is accepted by Departmental Representative.

3.6 QUALITY CONTROL TESTING

- .1 Inspection and Testing shall be carried out by the Contractor at a minimum frequency of one test per 250m²/lift.
- .2 Submit compaction test results to Departmental Representative for review and approval.
- .3 Satisfactory compaction test results to be submitted and approved prior to placement of subsequent materials.

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 31 05 16 - Aggregate Materials.

1.2 REFERENCES

- .1 ASTM International.
 - .1 ASTM C 117-13, Standard Test Methods for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 131-06, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
 - .3 ASTM C 136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .4 ASTM D 698-12e1, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).
 - .5 ASTM D 1557-12, Test Method for Labor ASTM D 1883-07e2, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
 - .6 ASTM D 4318-10e1, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Nova Scotia Transportation and Infrastructure Renewal (NSTIR).
 - .1 Standard Specification for Highway Construction and maintenance (latest edition).

1.3 SAMPLE PANELS AREAS

- .1 Submit in accordance with Section 01 33 00 – Submittal Procedures.

- .2 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Storage and Handling Requirements:
 - .1 Store materials in accordance with erosion and sedimentation control plan and Section 31 05 16 - Aggregate Materials.
 - .2 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Type 1 Material, to Division 3, Section 2 of the NSTIR Standard Specification for Highway Construction and Maintenance.

PART 3 EXECUTION

3.1 PLACEMENT AND INSTALLATION

- .1 Place granular base after sub-base or subgrade surface is inspected and approved in writing by Departmental Representative.
- .2 Placing:
 - .1 Construct granular base to depth and grade in areas indicated.
 - .2 Ensure no frozen material is placed.
 - .3 Place material only on clean unfrozen surface, free from snow and ice.
 - .4 Begin spreading base material on crown line or on high side of one-way slope.

- .5 Place material using methods which do not lead to segregation or degradation of aggregate.
- .6 Place material to full width in uniform layers not exceeding 200 mm compacted thickness.
 - .1 Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.
- .7 Shape each layer to smooth contour and compact to specified density before succeeding layer is placed.
- .8 Remove and replace that portion of layer in which material becomes segregated during spreading.
- .3 Compaction Equipment:
 - .1 Ensure compaction equipment is capable of obtaining required material densities.
- .4 Compacting:
 - .1 Compact to density not less than 100% maximum dry density to ASTM D 698.
 - .2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
 - .3 Apply water as necessary during compacting to obtain specified density.
 - .4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved in writing by Departmental Representative. Maximum compacted thickness: 150 mm.
 - .5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

3.2 SITE TOLERANCES

- .1 Finished base surface to be within plus or minus 10 mm of established grade cross section but not uniformly high or low.

3.3 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.

- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

3.4 PROTECTION

- .1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by Departmental Representative.

3.5 QUALITY CONTROL TESTING

- .1 Inspection and Testing shall be carried out by the Contractor at a minimum frequency of one test per 250m²/lift.
- .2 Submit compaction test results to Departmental Representative for review and approval.
- .3 Satisfactory compaction test results to be submitted and approved prior to placement of subsequent materials.

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and application of asphalt prime to granular base surface prior to asphalt paving.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.3 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
- .2 ASTM D140/D140M-09, Standard Practice for Sampling Bituminous Materials.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-16.1-M89, Cutback Asphalts for Road Purposes.
 - .2 CAN/CGSB-16.2-M89, Emulsified Asphalts, Anionic Type, for Road Purposes.

1.4 SUBMITTALS

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

1.5 QUALITY ASSURANCE

- .1 Upon request from Departmental Representative, submit manufacturer's test data and certification that asphalt prime material meets requirements of this Section in accordance with Section 01 33 00 - Submittal Procedures.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials to ASTM D140.
- .2 Provide, maintain and restore asphalt storage area.

PART 2 PRODUCTS

2.1 MATERIAL

- .1 Asphalt material: to. CAN/CGSB-16.2 grade: SS-1.
- .2 Sand blotter: clean granular material passing 4.75 mm sieve and free from organic matter or other deleterious materials.
- .3 Water: clean, potable, free from foreign matter.

2.2 EQUIPMENT

- .1 Pressure distributor to be:
 - .1 Designed, equipped, maintained and operated so that asphalt material can be:
 - .1 Maintained at even temperature.
 - .2 Applied uniformly on variable widths of surface up to 5 m.
 - .3 Applied at controlled rates from 0.2 to 5.4 L/m² with uniform pressure, and allowable variation from any specified rate not exceeding 0.1 L/m².

- .4 Distributed in uniform spray without atomization at temperature required.
- .2 Equipped with meter registering metres of travel per minute, visibly located to enable truck driver to maintain constant speed required for application at specified rate.
- .3 Equipped with pump having flow meter graduated in units of 5 L or less per minute passing through nozzles and readily visible to operator. Pump power unit to be independent of truck power unit.
- .4 Equipped with easily read, accurate and sensitive device which registers temperature of liquid in reservoir.
- .5 Equipped with accurate volume measuring device or calibrated tank.
- .6 Equipped with nozzles of same make and dimensions, adjustable for fan width and orientation.
- .7 Equipped with nozzle spray bar, with operational height adjustment.
- .8 Cleaned if previously used with incompatible asphalt material.

PART 3 EXECUTION

3.1 APPLICATION

- .1 Obtain Departmental Representative's approval of granular base surface before applying asphalt prime.
- .2 Anionic emulsified asphalt:
 - .1 Dilute asphalt emulsion with clean water at 1:1 ratio for application.
 - .2 Mix thoroughly by pumping or other method approved by Departmental Representative.
 - .3 Apply diluted asphalt emulsion at rate directed by Departmental Representative, but do not exceed 5 L/m².
 - .4 Apply diluted asphalt emulsion on damp surface unless otherwise directed by Departmental Representative.
- .3 Apply asphalt prime only on unfrozen surface.
- .4 Do not apply prime when air temperature is less than 10 degrees C or when rain is forecast within 2 hours.

- .5 Paint contact surfaces of curbs, gutters, headers, manholes and like structures with thin, uniform coat of asphalt prime material.
- .6 Where traffic is to be maintained, treat no more than one-half width of surface in one application.
- .7 Prevent overlap at junction of applications.
- .8 Do not prime surfaces that will be visible when paving is complete.
- .9 Apply additional material to areas not sufficiently covered as directed by Departmental Representative.
- .10 Keep traffic off primed areas until asphalt prime has cured set.
- .11 Permit prime to cure set before placing asphalt paving.

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and application of asphalt tack coat to an existing asphalt or concrete surface prior to asphalt paving.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.

1.3 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
- .2 ASTM D140/D140M-09 , Standard Practice for Sampling Bituminous Materials.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-16.2-M89, Emulsified Asphalts, Anionic Type, for Road Purposes.

1.4 SUBMITTALS

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.

1.5 QUALITY ASSURANCE

- .1 Upon request by Departmental Representative, submit manufacturer's test data and certification that asphalt tack coat material meets requirements of this section.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with. ASTM D140.
- .2 Provide, maintain and restore asphalt storage area.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Anionic emulsified asphalt: to CAN/CGSB-16.2, grade: SS-1.
- .2 Water: clean, potable, free from foreign matter.

2.2 EQUIPMENT

- .1 Pressure distributor to be:
 - .1 Designed, equipped, maintained and operated so that asphalt material can be:
 - .1 Maintained at even temperature.
 - .2 Applied uniformly on variable widths of surface up to 5 m.
 - .3 Applied at readily determined and controlled rates from 0.2 to 5.4 L/m² with uniform pressure, and with an allowable variation from any specified rate not exceeding 0.1 L/m².
 - .4 Distributed in uniform spray without atomization at temperature required.
 - .2 Equipped with meter, registering metres of travel per minute, visibly located to enable truck driver to maintain constant speed required for application at specified rate.
 - .3 Equipped with pump having flow meter graduated in units of 5 L or less per minute passing through nozzles and readily visible to operator. Pump power unit to be independent of truck power unit.
 - .4 Equipped with an easily read, accurate and sensitive device which registers temperature of liquid in reservoir.
 - .5 Equipped with accurate volume measuring device or calibrated tank.

- .6 Equipped with nozzles of same make and dimensions, adjustable for fan width and orientation.
- .7 Equipped with nozzle spray bar, with operational height adjustment.
- .8 Cleaned if previously used with incompatible asphalt material.

PART 3 EXECUTION

3.1 APPLICATION

- .1 Obtain Departmental Representative's approval of surface before applying asphalt tack coat.
- .2 Apply asphalt tack coat only on clean and dry surface.
- .3 Dilute asphalt emulsion with water at 1:1 ratio for application.
 - .1 Mix thoroughly by pumping or other method approved by Departmental Representative.
- .4 Apply asphalt tack coat evenly to pavement surface at rate as directed by Departmental Representative but not to exceed 0.7 L/m².
- .5 Paint contact surfaces of curbs, gutters, headers, manholes and like structures with thin, uniform coat of asphalt tack coat material.
- .6 Do not apply asphalt tack coat when air temperature is less than 10 degrees C or when rain is forecast within 2 hours of application.
- .7 Apply asphalt tack coat only on unfrozen surface.
- .8 Evenly distribute localized excessive deposits of tack coat by brooming as directed by Departmental Representative.
- .9 Where traffic is to be maintained, treat no more than one half of width of surface in one application.
- .10 Keep traffic off tacked areas until asphalt tack coat has set.
- .11 Re-tack contaminated or disturbed areas as directed by Departmental Representative.
- .12 Permit asphalt tack coat to set before placing asphalt pavement.

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for asphalt concrete paving for roads and parking lots.
- .2 Work includes fine grading, supply and placement of prime or tack coat and hot mix asphalt concrete.

1.2 RELATED SECTIONS

- .1 Section 31 23 33.01 -Excavating, Trenching and Backfilling.
- .2 Section 32 16 15 - Concrete Walks Curbs and Gutters.

1.3 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves Testing, Woven Wire, Metric.
 - .3 CAN/CGSB-16.2-M89, Emulsified Asphalts, Anionic Type, for Road Purposes.
 - .4 CAN/CGSB-16.3-M90, Asphalt Cements for Road Purposes.
- .2 Nova Scotia Department of Transportation and Infrastructure Renewal Standard Specification, Highway Construction and Maintenance, Latest Edition.

1.4 PRODUCT DATA

- .1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit asphalt concrete mix design and trial mix test results to Departmental Representative for approval at least 4 weeks prior to beginning Work.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Asphalt materials to Province of Nova Scotia Department of Transportation and Infrastructure Renewal Standard Specification and as indicated on the drawings.

2.2 EQUIPMENT

- .1 Pavers: mechanical grade controlled self-powered pavers capable of spreading mix within specified tolerances, true to line, grade and crown indicated.
- .2 Rollers: sufficient number of type and weight to obtain specified density of compacted mix.
- .3 Vibratory rollers:
 - .1 Minimum drum diameter: 750 mm.
 - .2 Maximum amplitude of vibration (machine setting): 0.5mm for lifts less than 40 mm thick.
- .4 Haul trucks: sufficient number and of adequate size, speed and condition to ensure orderly and continuous operation and as follows:
 - .1 Boxes with tight metal bottoms.
 - .2 Covers of sufficient size and weight to completely cover and protect asphalt mix when truck fully loaded.
 - .3 In cool weather or for long hauls, insulate entire contact area of each truck box.
- .5 Hand tools:
 - .1 Suitable hand tools.

2.3 MIX DESIGN

- .1 Mix design to be approved by Departmental Representative.
- .2 Mix design to Province of Nova Scotia Department of Transportation and Infrastructure Renewal Standard Specification and type as indicated on drawings.

- .3 Mix design shall meet the most recent requirements of the NSTIR Standard Specification.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Granular Sub-base as per Section 32 11 16.01 - Granular Sub-Base.
- .2 Granular Base as per Section 32 11 23 - Aggregate Base Courses.
- .3 Prior to placing asphalt surface course:
 - .1 Adjust manhole covers and catchbasin frames to match asphalt surface, using manufactured grade rings.
 - .2 Adjust valve boxes to finished asphalt surface. Raise or lower top sections of valve boxes.
- .4 Prior to laying mix, clean surfaces of loose and foreign material.

3.2 PLACING

- .1 Use workers skilled in placing asphalt concrete.
- .2 Obtain Departmental Representative approval of all materials prior to placing asphalt.
- .3 Place asphalt concrete to thicknesses, grades and lines as indicated on the Drawings and as approved by the Departmental Representative.
- .4 Placing conditions:
 - .1 Place asphalt mixtures only when air temperature is above 5 degrees C.
 - .2 When temperature of surface on which material is to be placed falls below 10 degrees C, provide extra rollers as necessary to obtain required compaction before cooling.
 - .3 Do not place hot-mix asphalt when pools of standing water exist on surface to be paved, during rain, or when surface is damp.
- .5 Place asphalt concrete in compacted lifts of thickness as indicated on drawings and as follows:
 - .1 Maximum lift thickness to be 65 mm.

- .6 Minimum 135°C mix temperature required when spreading.
- .7 Maximum 160°C mix temperature permitted at anytime.

3.3 COMPACTING

- .1 Compact all paved areas to a density of not less than 95% of density obtained with Marshall specimens prepared in accordance with ASTM D 1559-89 from samples of mix being used. Roll until roller marks are eliminated.
- .2 General:
 - .1 Start rolling operations as soon as placed mix can bear weight of roller without excess displacement of material or cracking of surface.
 - .2 Operate roller slowly initially to avoid displacement of material. Do not exceed 5 km/h for breakdown and intermediate rolling for static steel-wheeled and pneumatic tired rollers. Do not exceed 9 km/h for finish rolling.
 - .3 Overlap successive passes of roller by minimum of 200 mm and vary pass lengths.
 - .4 Keep wheels of roller slightly moistened with water to prevent pick-up of material but do not over-water.
 - .5 Do not stop vibratory rollers on pavement that is being compacted with vibratory mechanism operating.
 - .6 Do not permit heavy equipment or rollers to stand on finished surface before it has been compacted and has thoroughly cooled.
 - .7 After traverse and longitudinal joints and outside edge have been compacted, start rolling longitudinally at low side and progress to high side. Ensure that all points across width of pavement receive equal numbers of passes of compactors.
 - .8 Where rolling causes displacement of material, loosen affected areas at once with lutes or shovels and restore to original grade of loose material before re-rolling.
 - .9 Compact mix with hot tampers or other equipment approved by Departmental Representative, in areas in accessible to Roller.

3.4 JOINTS

.1 General:

- .1 Remove surplus material from surface of previously laid strip. Do not deposit on surface of freshly laid strip.
- .2 Paint contact surfaces of existing structures such as manholes, curbs or gutters with bituminous material prior to placing adjacent pavement.

.2 Transverse joints:

- .1 Offset transverse joint in succeeding lifts by at least 600 mm.
- .2 Cut back to full depth vertical face and tack face with thin coat of hot asphalt prior to continuing paving.
- .3 Compact transverse joints to provide smooth riding surface. Use methods to prevent rounding of compacted surface at joints.

.3 Longitudinal joints:

- .1 Offset longitudinal joints in succeeding lifts by at least 150 mm.
- .2 Cold joint is defined as joint where asphalt mix is placed, compacted and left to cool below 100 degrees C prior to paving of adjacent lane.
 - .1 If cold joint cannot be avoided, cut back by saw cutting previously laid lane, by at least 150 mm, to full depth vertical face, and tack face with thin coat of hot asphalt of adjacent lane.
- .3 Overlap previously laid strip with spreader by 25 to 50 mm.
- .4 Before rolling, carefully remove and discard coarse aggregate in material overlapping joint with lute or rake.
- .5 Roll longitudinal joints directly behind paving operation.
- .6 When rolling with static or vibratory rollers, have most of drum width ride on newly placed lane with remaining 150 mm extending onto previously placed and compacted lane.

3.5 FINISH TOLERANCES

- .1 Finished asphalt surface to be within 6 mm of design elevation but not uniformly high or low.
- .2 Finished asphalt surface not to have irregularities exceeding 6 mm when checked with 3 m straight edge placed in any direction.

3.6 DEFECTIVE WORK

- .1 Correct irregularities which develop before completion of rolling by loosening surface mix and removing or adding material as required. If irregularities or defects remain after final compaction, remove surface course promptly and lay new material to form true and even surface and compact immediately to specified density.
- .2 Repair areas showing checking, rippling, or segregation.
- .3 Adjust roller operation and screed settings on paver to prevent further defects such as rippling and checking of pavement.

3.7 PROTECTION

- .1 Keep vehicular traffic off newly paved areas until paving surface temperature has cooled below 38°C. Do not permit stationary loads on pavement until 24 hours after placement.
- .2 Provide access to buildings as required. Arrange paving schedule so as not to interfere with normal use of premises.

3.8 QUALITY CONTROL TESTING

- .1 Contractor shall be responsible for the necessary quality testing and adjustments to produce uniform, acceptable hot-mix asphalt mixes in conformance with the Contract documents.
- .2 A minimum of 3 core samples shall be collected and tested for each lift of asphalt at areas selected by the Departmental Representative.
- .3 Departmental Representative reserves the right to request a bulk sample analysis be conducted during paving operations to verify mix design.
- .4 Contractor shall conduct quality control testing to meet Provincial Standards. No payment will be made for asphalt paving until satisfactory quality control results have been submitted by the Contractor.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 74 20 - Waste Managing and Disposal.
- .2 Section 03 10 00 - Concrete Forming and Accessories.
- .3 Section 03 20 00 - Concrete Reinforcing.
- .4 Section 03 30 00 - Cast-in-Place Concrete.
- .5 Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .6 Section 32 12 16 - Asphalt Paving.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM D 698-12, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft³) (600kN-m/m³).
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.2-98, Boiled Linseed Oil.
 - .2 CAN/CGSB-3.3-2007, Kerosene.
- .3 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Practices for Concrete.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20 - Waste Managing and Disposal.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Concrete mixes and materials: to Section 03 30 00 - Cast-in-Place Concrete.
- .2 Reinforcing steel: to Section 03 20 00 - Concrete Reinforcing.
- .3 Joint filler and Curing Compound: to Section 03 30 00 - Cast-in-Place Concrete.
- .4 Granular base: to Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .5 Non-staining mineral type form release agent: chemically active release agents containing compounds that react with free lime to provide water soluble soap.
- .6 Fill material: to Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .7 Boiled linseed oil: to CAN/CGSB-1.2.
- .8 Kerosene: to CAN/CGSB-3.3.

PART 3 EXECUTION

3.1 GRADE PREPARATION

- .1 Do grade preparation work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Construct embankments using excavated material free from organic matter or other objectionable materials. Dispose of surplus and unsuitable excavated material off site at approved location.
- .3 When constructing embankment, provide for minimum 0.5 m shoulders, where applicable, outside of neat lines of concrete.
- .4 Place fill in maximum 150 mm layers and compact to at least 100% of maximum density to ASTM D 698.

3.2 GRANULAR BASE

- .1 Obtain Departmental Representative's approval of subgrade before placing granular base.
- .2 Place granular base material to lines, widths, and depths as indicated.
- .3 Compact granular base to at least 100% of maximum density to ASTM D 698.

3.3 CONCRETE

- .1 Obtain Departmental Representative's approval of granular base and reinforcing steel prior to placing concrete.
- .2 Do concrete work in accordance with Section 03 30 00 - Cast-in-Place Concrete.
- .3 Immediately after floating, give sidewalk surface uniform broom finish to produce regular corrugations not exceeding 2 mm deep, by drawing broom in direction normal to centre line.
- .4 Provide edging as indicated with 10 mm radius edging tool.
- .5 Slip-form pavers equipped with string line system for line and grade control may be used if quality of work acceptable to Departmental Representative can be demonstrated. Hand finish surfaces when directed by Departmental Representative.

3.4 TOLERANCES

- .1 Finish surfaces to within 3 mm as measured with 3 m straightedge placed on surface.

3.5 EXPANSION AND CONTRACTION JOINTS

- .1 Install tooled transverse contraction joints after floating, when concrete is stiff, but still plastic, at intervals of 3m for curbs and 1.5 m for sidewalks.
- .2 Install expansion joints as directed by Departmental Representative or at intervals of 6 m.

- .3 When sidewalk is adjacent to curb, make joints of curb, gutters and sidewalk coincide.

3.6 ISOLATION JOINTS

- .1 Install isolation joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structure.
- .2 Install joint filler in isolation joints in accordance with Section 03 30 00 - Cast-in-Place Concrete or as indicated.
- .3 Seal isolation joints with sealant approved by Departmental Representative.

3.7 CURING

- .1 Cure concrete by adding moisture continuously in accordance with CAN/CSA-A23.1 to exposed finished surfaces for at least 1 day after placing, or sealing moisture in by curing compound approved by Departmental Representative.
- .2 Where burlap is used for moist curing, place two pre-wetted layers on concrete surface and keep continuously wet during curing period.
- .3 Apply curing compound evenly to form continuous film. In accordance with manufacturer's requirements.

3.8 BACKFILL

- .1 Allow concrete to cure for 7 days prior to backfilling.
- .2 Backfill to designated elevations with material approved by Departmental Representative. Compact and shape to required contours as indicated or as directed by Departmental Representative.

3.9 LINSEED OIL TREATMENT

- .1 After concrete has cured for specified curing time and when surface of concrete is clean and dry, apply two coats of linseed oil mixture uniformly to surfaces of sidewalks, curbs, walks and gutters.

- .2 Linseed oil mixture to consist of 50% boiled linseed oil and 50% mineral spirits by volume.
- .3 Apply treatment when air temperature above 10°C.
- .4 Apply first coat at 135 mL/m².
- .5 Apply second coat at 90 mL/m² when first coat has dried.

PART 1 GENERAL

1.1 REFERENCES

- .1 CAN/CGSB-1.5-M91, Low Flash Petroleum Spirits Thinner.
- .2 CGSB 1-GP-12c-68, Standard Paint Colours.
- .3 CGSB 1-GP-71(2003), Methods, of Testing Paints and Pigments.
- .4 CGSB 1-GP-74M, Paint, Traffic, Alkyd.
- .5 Transportation Association of Canada, Manual of Uniform Traffic Control Devices of Canada, Part C.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Paint:
 - .1 To CGSB 1-GP-74M, alkyd traffic paint.
 - .2 Colour: to CGSB 1-GP-12C, yellow 505-308 and white 513-301.
 - .3 Glass beads for paint shall be Type I, Grade A, 1.5 low index.
- .2 Thinner: to CAN/CGSB-1.5-M91.

PART 3 EXECUTION

3.1 EQUIPMENT REQUIREMENTS

- .1 Paint applicator to be an approved pressure type mobile distributor capable of applying paint in single, double and dashed lines. Applicator to be capable of applying marking components uniformly, at rates specified, and to dimensions as indicated, and to have positive shut-off.

3.2 CONDITION OF SURFACES

- .1 Pavement surface to be dry, free from ponded water, frost, ice, dust, oil, grease and other foreign materials.

3.3 APPLICATION

- .1 Pavement markings to be laid out as per the Drawings unless otherwise specified by the Departmental Representative.
- .2 Unless otherwise approved by Departmental Representative, apply paint only when air temperature is above 10°C, wind speed is less than 60 km/h and no rain is forecast within next 4 hours.
- .3 Apply traffic paint evenly at rate of 3m²/L.
- .4 Do not thin paint unless approved by Departmental Representative.
- .5 Symbols and letters to conform to dimensions indicated.
- .6 Paint lines to be of uniform colour and density with sharp edges.
- .7 Thoroughly clean distributor tank before refilling with paint of different colour.

3.4 TOLERANCE

- .1 Paint markings to be within plus or minus 12mm of dimensions indicated.
- .2 Protect pavement markings until dry.

Part 1 General

1.1 WORK INCLUDED

- .1 To complete topsoil and finish grading to contours and elevations as shown on Drawings, as specified, or as required, and summarized but not restricted to:
 - .1 Preparation of Subgrade, provision, placement and fine grading of topsoil for sodded lawn areas and swales.
 - .2 Preparation of Subgrade, provision, placement and fine grading of topsoil for hydroseeded lawn areas.
 - .3 Preparation of Subgrade, provision and placement of planting soil mixture for planting beds and individual planting pits.

1.2 RELATED WORK

- .1 Section 01 35 43 Environmental Procedures
- .2 Section 31 23 10 Earthwork
- .3 Section 32 92 23 Sodding
- .4 Section 32 93 10 Trees, Shrubs, and Groundcover Planting

1.3 REFERENCES

- .1 Landscape Nova Scotia Standard Topsoil Triangle
- .2 ASTM D698-12e1 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³))

1.4 SOURCE QUALITY CONTROL

- .1 The Contractor shall submit representative samples of topsoil, and samples of any stockpiled topsoil that is to be used on the project to a Soil Plant Testing Laboratory acceptable to the Departmental Representative. Prior to using these materials on site they must meet the requirements as indicated in the project specifications. Information to be obtained from testing includes the following:
 - .1 Soil type classification.
 - .2 Percent organic matter.
 - .3 Chemical soil test.
 - .4 Recommendation for soil amendments and fertilizers.
- .2 Contractor to pay for costs of testing.
- .3 Perform pH test to determine required treatment to bring pH value of soil to 6.0 to 7.5 level
- .4 Submit two copies of soil analysis and recommendations for corrections to Departmental Representative.

1.5 **SCHEDULING**

- .1 No topsoil is to be placed before soil testing results have been provided by Contractor and approved by the Departmental Representative.
- .2 Schedule placing of topsoil and finish grading to permit sodding operations under optimum conditions.

1.6 **PROTECTION**

- .1 Prevent damage to trees, landscaping, natural features, bench marks, existing buildings, windows, existing pavement, culverts, and utility lines which are to remain. Make good any damage.
- .2 Protect newly graded and filled areas from washouts and settlements caused by rain and water drainage. Fill and grade settled or washed out areas to required levels and slopes under Work of this Section.

Part 2 **Products**

2.1 **MATERIALS**

- .1 Imported topsoil shall conform to the following characteristics unless otherwise specified. Be natural, fertile, friable and classified as either a loam or sandy loam texture. Contain not less than 3%, or more than 8%, by weight of decayed organic matter (humus). All materials shall be taken from a well drained, arable site, free from subsoil, debris, vegetation, toxic materials, and stones and roots over 25mm max. dimension. Topsoil shall be free of grassy weeds such as quack grass and noxious weeds. Material shall have a pH of between 6.0 and 7.5. Topsoil to be rated to Landscape Nova Scotia Standard Topsoil Triangle, latest revision, rating: B. If material does not meet minimum specifications it must be amended with an approved material and tested at the expense of the Contractor.
- .2 Manure: Well rotted, unleached cattle manure, not less than eight months or more than two years old, free of harmful chemicals and substances, containing no more than 25% straw, leaves or other materials unsuitable for planting use.
- .3 Peat moss:
 - .1 Derived from partially decomposed fibrous or cellular stems and leaves of sphagnum mosses.
 - .2 Elastic and homogeneous, brown in colour.
 - .3 Free of wood and deleterious material which could inhibit growth.
 - .4 Shredded particle minimum size 6mm.
- .4 Bonemeal: Raw bonemeal, finely ground with a minimum analysis of 2% nitrogen and 20% phosphoric acid.
- .5 Fertilizer:
 - .1 Complete non-toxic, no-burning, organic, slow-release fertilizer.

- .2 Fertilizer analysis for hydroseeding areas as determined from soil sample test to be approved by Departmental Representative.
- .6 Limestone:
 - .1 Ground agricultural limestone containing minimum 85% of total carbonates.
 - .2 Gradation requirements: percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.
- .7 Planting Soil Mixture for trees, shrubs and ground covers. Mechanically mix: 6 parts topsoil, with 1 part well-rotted manure, and 3 parts peat moss.
 - .1 Incorporate bonemeal at rate of 2.75 kg per cu. meter
 - .2 Incorporate fertilizer at rate determined by soil sample test.

Part 3 Execution

3.1 GENERAL

- .1 Where required, establish Subgrade with Select Backfill as defined, deposit in layers not exceeding 200mm. Consolidate each layer to minimum 95% Standard Proctor Density.

3.2 PREPARATION OF SUBGRADE

- .1 Grade Subgrade, eliminating uneven areas and low spots, ensuring positive drainage. Remove soil contaminated with toxic materials. Dispose of removed materials from site as required by the Nova Scotia Environment.
- .2 Cultivate entire area that is to receive topsoil to depth of 100mm. Repeat cultivation in those areas where equipment used for hauling and spreading has compacted soil.
- .3 Remove surface debris, roots, vegetation, branches and stones in excess of 25mm dimension.

3.3 PREPARATION OF LAWNS AND PLANTING BEDS

- .1 Establish subgrade for lawn areas and planting beds and request review by Departmental Representative.
 - .1 150mm depth for sodded lawn areas.
 - .2 125mm depth for areas to be hydroseeded.
 - .3 600mm deep and 915mm diameter for all individual tree planting pits to ensure min. 300 planting soil around root ball.
- .2 Place and compact planting soil in bottom of tree pits to support tree in position, as indicated on Drawings.

3.4 EROSION CONTROL

- .1 Install and maintain erosion controls to prevent erosion of topsoil.

3.5 **SPREADING OF TOPSOIL AND FINISH GRADING**

- .1 Spread topsoil to the following depths after Departmental Representative has inspected and approved Subgrade:
 - .1 125mm for sodded areas.
 - .2 125mm for areas to be hydroseeded.

- .2 Spread topsoil with adequate moisture in uniform layers over approved, unfrozen subgrade where planting is indicated.

- .3 Fine grade entire topsoil area to contours and elevations indicated on Drawings +/- 25mm or as directed. Eliminate rough spots and low areas as directed.

- .4 Roll topsoil with 45 kg. roller, min. 915mm wide to consolidate topsoil.

- .5 Apply planting soil mixture to following min. depths:
 - .1 600mm for planting beds.
 - .2 600mm for individual plant pits (as outlined above, in Section 32 93 10 – Trees, Shrubs and Ground Cover Planting, and as shown on Drawings.

3.6 **SURPLUS MATERIALS**

- .1 Dispose of surplus topsoil not required for fine grading and landscaping off-site.

END OF SECTION

PART 1 General

1.1 WORK INCLUDED

- .1 Establishment of turf and /or vegetative cover by means of hydraulic seeding as shown or required and as specified herein, including:
 - .1 Application of hydroseed mixture (and reapplications as necessary).
 - .2 Maintenance and warranty for one year from date of Substantial Completion of Contract.

1.2 RELATED WORK

- .1 Section 01 35 43 Environmental Procedures
- .2 Section 32 91 21 Topsoil and Finish Grading
- .3 Section 32 92 23 Sodding

1.3 PRODUCT DATA

- .1 Provide product data for:
 - .1 Seed.
 - .2 Mulch.
 - .3 Tackifier.
 - .4 Fertilizer.

1.4 SCHEDULING

- .1 Schedule hydroseeding to coincide with topsoil operations.

1.5 WARRANTY

- .1 The Contractor hereby warrants that hydroseeded lawn areas will remain free of defects in accordance with conditions outlined in this specification for one full year from date of Substantial Completion.

PART 2 Products

2.1 MATERIALS

- .1 Grass seed: Common No. 1 Grade to Government of Canada, Seeds Regulations.
- .2 Mulch:
 - .1 Fibre: wood or wood-cellulose fibres free of germination or growth-inhibiting ingredients and forming blotter like ground cover allowing absorption and percolation of water.

- .2 Capable of dispersing in water to form homogeneous slurry.
- .3 Capable of forming an absorptive mat ground cover allowing water percolation.
- .3 Tackifier: water diluted liquid dispersion containing polyvinyl acetate terpolymer emulsion.
- .4 Water: potable, free of impurities that would inhibit germination.
- .5 Fertilizer:
 - .1 Type 1: complete synthetic, slow release fertilizer with minimum 65% water soluble nitrogen – Ratio: 1:4:4.
 - .2 Type 2: complete synthetic, slow release fertilizer with maximum 35% water soluble nitrogen – Ratio: 2:1:1.

2.2 GRASS SEED MIXTURE

- .1 Spread seed mixture at 160 kg per hectare minimum. Seed mix to consist of:
 - .1 40% Kentucky Bluegrass.
 - .2 40% Creeping Red Fescue.
 - .3 20% Artic Green Perennial Rye Grass.

2.3 EQUIPMENT

- .1 Truck:
 - .1 Slurry tank: approved commercial hydraulic equipment.
 - .2 Pumps capable of maintaining continuous non-fluctuating flow of solution.

PART 3 Execution

3.1 WORKMANSHIP

- .1 Take reasonable care to prevent spraying items such as structures, signs, guide rails, fences, plant material and utilities.
- .2 Where contamination occurs remove seeding slurry to satisfaction of, and by means approved by Departmental Representative.
- .3 Do not perform work under adverse field conditions such as wind speeds over 10 km/h, frozen ground or ground covered with snow, ice or standing water, or temperatures which will inhibit seed germination.

3.2 PREPARATION OF SURFACES

- .1 General:
 - .1 Cultivate areas to be seeded to a depth of 50mm.

- .2 Ensure areas are moist to depth of 150mm before seeding. Fine grade free of humps and hollows and free of deleterious and refuse material.
- .3 Obtain Departmental Representative's approval of topsoil grade and depth before starting seeding.
- .4 Grade to finish elevations indicated +/- 25mm.
- .5 Remove stones greater than 25mm diameter within top 100mm of finish Subgrade.
- .6 Supply and place 125mm of topsoil – See Section 32 91 21 – Topsoil and Finish Grading.

3.3 SEEDING

- .1 Seed areas to within 2 weeks of freeze-up.
- .2 Apply seed slurry uniformly and when winds are less than 10 km/hr.
- .3 Slurry mixture applied per acre, based on tank size of 10,000 L:
 - .1 Seed (mixture as spec'd): 57 kg.
 - .2 Mulch: 400 kg.
 - .3 Tackifier: 115 kg.
 - .4 Fertilizer, Type 1: 180 kg.
 - .5 Water: as required to form slurry in accordance with manufacturer's recommendations.
- .4 Blend applications into adjacent sodded areas and previous applications to form uniform surfaces.
- .5 Re-shoot areas where application is not uniform.
- .6 Remove slurry from items and areas not designated to be sprayed.

3.4 ACCEPTANCE OF HYDROSEED APPLICATION FOR PAYMENT

- .1 Hydro-seeded areas will be accepted for payment provided:
 - .1 Seeded areas are uniformly established and turf is free of rutted, eroded, bare or dead spots and 98% free of weeds.
 - .2 No surface soil is visible when grass has been cut to 100mm height.
 - .3 Seeded areas have been cut at least twice.
- .2 Areas seeded in fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.

3.5 MAINTENANCE - GENERAL

- .1 Commence maintenance immediately following acceptance of hydroseed application and continue it for 1-year (the guarantee period) following Substantial Completion of the Contract.

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- .2 Maintain hydroseeded areas to ensure vigorous and healthy growth. Maintenance shall consist of, but not be limited to:
 - .1 Water seeded area as required to ensure germination and continued growth of grass.
 - .2 Fertilize seeded areas in Spring after threat of final frost has past. Use Type 2 fertilizer, ratio 2:1:1, at rate of 445 kg. per hectare. Postpone fertilizing until following spring if application falls within four week period prior to expected end of growing season.
 - .3 Repair dead or bare spots to allow establishment prior to acceptance.
 - .4 Eliminate weeds in excess of 10% of coverage.
 - .3 This maintenance will be the sole source of maintenance of the Work during this period and wholly the Contractor's responsibility.
 - .4 Notify Departmental Representative upon completion of maintenance period to arrange inspection and transfer maintenance responsibility to Owner.
 - .5 Include the cost of lawn maintenance in the Total Tender Price in the Form of Tender.

3.6 ACCEPTANCE AT END OF MAINTENANCE PERIOD

- .1 Notify Departmental Representative upon completion of maintenance period to arrange inspection and transfer maintenance responsibility.
- .2 Hydroseeded lawn areas will be accepted at end of maintenance period by Departmental Representative provided:
 - .1 Seeded areas are uniformly established and plant material turf is free of rutted, eroded, and bare or dead spots.
 - .2 Turf is free of bare and dead spots and with maximum 5% weed coverage.
 - .3 No surface soil is visible when grass has been cut to height of 50 mm.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 To complete sodding as shown, specified or required, and summarized but not restricted to:
 - .1 Sodding of lawn areas and swales indicated within contract limits.
 - .2 Maintenance and warranty.

1.2 RELATED WORK

- .1 Section 01 35 43 Environmental Procedures
- .2 Section 32 91 21 Topsoil Placement and Finish Grading

1.3 SOURCE QUALITY CONTROL

- .1 Obtain approval from Departmental Representative of sod source.
- .2 When proposed source of sod is approved, use no other source without written authorization.
- .3 Sod shall be machine cut and harvested at a uniform thickness of 25mm plus or minus 6mm. Measurement of thickness shall exclude top growth and thatch.

1.4 SCHEDULING

- .1 Schedule sod laying to coincide with topsoil operations.

Part 2 Products

2.1 MATERIALS

- .1 Nursery sod: Quality and source to comply with standards outlined in Canadian Nursery Trends Association - Canadian Standards for Nursery Stock – current edition.
 - .1 Number One Kentucky Bluegrass / Fescue Sod: sod grown from minimum 40% Kentucky Bluegrass, 30% Creeping Red Fescue, or approved equal.
 - .2 Broken, dry, discoloured pieces will be rejected by Departmental Representative.
 - .3 Sod to be rectangular strips measuring 300mm or 400mm in width and from 600mm to 1500mm in length.
 - .4 All sod to be harvested, delivered and transplanted within a period of twenty-four hours.
- .2 Water: free of impurities that would inhibit establishment and growth.
- .3 Sodding stakes: 25mm x 25mm x 200mm long wooden pegs or approved 200mm long steel staples.
- .4 Fertilizer: Complete, synthetic, slow release with maximum 35% water soluble nitrogen.

- .1 Ratio for turf establishment treatment: 18-24-2 (60% SCU) at the rate of 2.3 kgs/100 square metres.
- .2 Ratio for Spring sodding: 1:2:2.
- .3 Ratio for Year 1 maintenance applications:
- .4 May: 30:0 July: 3:1:3 Sept. 1:2:3
- .5 Rates: prior to seeding at not less than 165 kg. phosphorus per hectare.
- .6 Herbicide: type, rate, and method of application subject to approval by Departmental Representative.

Part 3 Execution

3.1 WORKMANSHIP

- .1 Keep site well drained.
- .2 Clean up immediately soil or debris spilled onto pavement and dispose of deleterious materials.

3.2 LAYING OF SOD

- .1 Prior to sodding, obtain approval from Departmental Representative that finished grade and depth of topsoil are satisfactory.
- .2 Apply fertilizer at rate for turf establishment and as recommended by soil sample test.
- .3 Cultivate topsoil as required to alleviate compaction during placement and to provide a slightly roughened surface to accept sodding application.
- .4 Ensure topsoil is moist to a depth of 100mm prior to sodding.
- .5 Lay sod within 24 hours after cutting to ensure proper establishment.
- .6 Sodding during excessively wet conditions, at freezing temperatures or over frozen soil is subject to approval.
- .7 Lay sod in rows, parallel with contours, smooth and flush with adjoining areas, and with joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Butt sections against curbs and walkways flush with top of concrete, ensure topsoil is well-compacted beside concrete. Cut out irregular or thin sections with a sharp knife, edger or equivalent. Where sod abuts concrete curb, compact soil behind curb and lay top of sod flush with top of curb.
- .8 Provide close contact between sod and soil by light rolling. Use of heavy roller to correct irregularities in grade is not permitted.
- .9 Water sod immediately after laying to obtain moisture penetration through sod into top 100mm of topsoil.
- .10 Sodded areas to be inspected by Departmental Representative prior to commencement of maintenance period.

3.3 PROTECTION

- .1 Provide adequate protection of sodded areas against erosion and pedestrian, vehicular, and mechanical damage. Remove protection after lawn areas have been accepted.

3.4 **ACCEPTANCE AT COMPLETION OF INSTALLATION**

- .1 Sodded areas will be accepted after installation provided that:
 - .1 Sodded areas are properly established.
 - .2 Sod is free of bare and dead spots and without weeds.
 - .3 There are no visible gaps between adjacent pieces of sod..
 - .4 Sodded areas have been cut minimum 2 times.
- .2 Lawns sodded in late fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.

3.5 **MAINTENANCE**

- .1 Commence maintenance immediately following installation of sodding and continue it for one year (the guarantee period) following Substantial Completion of Contract.
- .2 Maintain sodded lawn areas to ensure vigorous and healthy growth. Maintenance consists of, but is not limited to: mowing, removal of heavy clippings, edging, clipping, weed control, repair of erosion, watering, fertilizing, re-sodding to maintain uniform growth, and maintaining barricades to prevent damage by traffic.
- .3 Watering: Water grass daily and if necessary continuously during the normal 8 hour working day to achieve moisture penetration to a depth of 100mm. The contractor is responsible for supplying all equipment, hoses, connections, etc. for watering during the guarantee period.
- .4 Cut grass to 65mm when it reaches height of 100mm. Remove clippings which will smother sodded areas. Maintain sodded areas weed free.
- .5 Fertilize sodded areas one month after sodding with 2:1:1 ratio fertilizer and as specified in sub-section 2.1.5. Spread evenly at rate of .45 kg of actual nitrogen / 100 square metres and water in well. Postpone fertilizing until next spring if application falls within four week period prior to expected end of growth season.
- .6 This maintenance will be the sole source of maintenance of the Work during this period and is wholly the Contractor's responsibility.
- .7 Notify Departmental Representative upon completion of maintenance period to arrange inspection and transfer maintenance responsibility.
- .8 Include the cost of lawn maintenance in the Total Tender Price in the Form of Tender.

3.6 **WARRANTY PERIOD**

- .1 Guarantee sodded areas for one year from date of Substantial Completion of Contract.

3.7 **ACCEPTANCE AT END OF WARRANTY PERIOD**

- .1 Sodded areas will be accepted at the end of the warranty period provided that:
 - .1 Sodded areas are properly established.
 - .2 Sod is free of bare and dead spots and with maximum 5% weed coverage.

.3 No surface soil is visible when grass has been cut to height of 50mm.

END OF SECTION

Part 1 General

1.1 WORK INCLUDED

- .1 To complete planting of trees as shown, specified, or required, and summarized, but not restricted to:
 - .1 Supply and placement of planting soil mix.
 - .2 Supply and planting of trees, shrubs and groundcovers complete with all related components and accessories.
 - .3 Maintenance and warranty.

1.2 RELATED WORK

- .1 Section 01 35 43 Environmental Procedures
- .2 Section 32 91 21 Topsoil and Finish Grading

1.3 REFERENCE STANDARDS

- .1 Perform planting of trees, shrubs and ground covers work in accordance with the Canadian Nursery Trades Association Canadian Standards (CNTA) for Nursery Stock – latest edition except where specified otherwise.

1.4 SOURCE QUALITY CONTROL

- .1 Obtain approval from Departmental Representative of plant material prior to planting.
- .2 Acceptance of plant material does not prevent rejection after planting operations as a result of damage during planting operations, or failure of growth.
- .3 Imported plant material must be accompanied with necessary permits and import licenses. Conform to federal and provincial regulations.

1.5 DELIVERY, STORAGE & PROTECTION

- .1 Protect plant material from damage during transportation. Use enclosed vehicle or other method approved by Departmental Representative.
- .2 Immediately store and protect plant material which will not be installed within 1 hour after arrival at site in storage location approved by Departmental Representative.
- .3 Protect plant material from frost, excessive heat, wind and sun during and after delivery as follows:
 - .1 For pots and container, maintain moisture level in containers.
 - .2 For balled and burlapped and wire basket root balls, place to protect branches from damage. Maintain moisture level in root zones.

1.6 **WARRANTY**

- .1 The Contractor hereby warrants that plant material as itemized on plant list will be maintained to remain healthy and free of defects for **2 year** from date of Substantial Completion of contract.
- .2 End-of-warranty inspection will be conducted by Departmental Representative.
- .3 Departmental Representative reserves the right to extend Contractor's warranty responsibilities for an additional one year if, at end of initial warranty period, leaf development and growth is not sufficient to ensure future survival.

1.7 **REPLACEMENTS**

- .1 During warranty period, remove from site any plant material that has died or failed to grow satisfactorily as determined by Departmental Representative.
- .2 Replace plant material at the beginning of the next planting season if balled and burlapped or wire basket material. Container grown plants of equal size can be replaced during suitable growing conditions.
- .3 Extend warranty on replacement plant material for a period equal to the original warranty period.

Part 2 **Products**

2.1 **PLANT MATERIAL**

- .1 Type of root preparation, sizing, grading and quality: comply with Canadian Nursery Trades Association Canadian Standards for Nursery Stock – latest edition.
- .2 Plant material: free of disease, insects, defects or injuries and structurally sound with strong fibrous root system.
- .3 Plant material: root pruned regularly.
- .4 Trees: to CNTA Standards, with straight trunks, well and characteristically branched for species except where specified otherwise.
- .5 Bare root stock: not acceptable.
- .6 Collected (native) stock: not acceptable.
- .7 Substitutions to plant material indicated on planting plan is not permitted unless written permission has been obtained as to size, type, variety, and quantity. Substitutions must be of similar species as originally specified.

2.2 **WATER**

- .1 Free of impurities that would inhibit plant growth.

2.3 **TREE STAKES**

- .1 Round, wooden stakes, 75mm to 100mm dia., pointed one end, 3m long.

2.4 **GUYING WIRE**

- .1 Galvanized steel, 3mm wire or 3mm diameter multi-wire steel cable.

2.5 **GUYING COLLAR**

- .1 Tube: plastic, 12mm diameter, nylon reinforced.

2.6 **TURNBUCKLE**

- .1 Galvanized steel, 10 mm diameter with 250 mm open length. Painted fluorescent orange.

2.7 **FERTILIZER**

- .1 Commercial type, as determined by soil sample test. Organic product acceptable substitute, provided it will supply the nutrient requirements determined by soil sample test.

2.8 **ANTI-DESICCANT**

- .1 Wax-like emulsion to approval of Departmental Representative.

2.9 **MULCH**

- .1 Double grinded bark mulch: varying in size from 25mm to 75mm in length, from coniferous trees. Minimum of 75% of the mulch will pass through a 1" screen. Mulch shall be free of growth or germination-promoting ingredients. The bark mulch will have the characteristics of retaining moisture, forming a mat not susceptible to spreading by wind or rain, and providing a good growth medium for plants. Shredded bark may contain up to 25% shredded wood material. Bark mulch containing shredded wood shall be aged for one year minimum prior to installation.

Part 3 **Execution**

3.1 **PRE-PLANTING OPERATIONS**

- .1 Ensure plant material acceptable to Departmental Representative.
- .2 Remove damaged roots and branches from plant material.
- .3 Request nursery to apply anti-desiccant to conifers and deciduous trees in leaf in accordance with manufacturer's instructions.

3.2 **EXCAVATION AND PREPARATION OF PLANTING BEDS**

- .1 Preparation of planting beds is specified in Section 32 91 21 – Topsoil Placement and Grading.

- .2 For individual planting holes:
 - .1 Stake out location and obtain approval from Departmental Representative prior to excavating.
 - .2 Excavate to depth and width indicated.
 - .3 Remove subsoil, rocks, roots, debris and toxic materials from excavated material that will not be used as planting soil. Dispose of excess material.
 - .4 Scarify sides of planting hole.
 - .5 Remove water which enters excavations prior to planting. Notify Departmental Representative if water source is ground water.

3.3 PLANTING

- .1 For jute burlapped root balls, cut away top one-third of wrapping and wire basket without damaging root ball. Do not pull burlap or rope from under root ball.
- .2 For container stock or root balls in non-degradable wrapping, water plants before removing container. Remove container or wrapping without damaging root ball.
- .3 Plant vertically in locations as indicated. Orient plant material to give best appearance in relation to structure, roads and walks.
- .4 For trees and shrubs:
 - .1 Backfill soil in 150mm lifts. Lightly tamp each lift and water to eliminate air pockets. When two thirds of depth of planting pit has been backfilled, fill remaining space with water. After water has penetrated into soil, backfill to finish grade.
 - .2 Form watering saucer as indicated.
 - .3 Water plant material thoroughly after planting operations are complete. After soil settlement has occurred, fill with soil to finish grade.
 - .4 Dispose of burlap, wire, and container material off site.
- .5 After soil settlement has occurred, fill with soil to finish grade.

3.4 TREE SUPPORTS

- .1 Install tree supports as indicated on drawings.
- .2 Use double stake tree support for deciduous trees.
 - .1 Place one stake on prevailing wind side of tree and second opposite or as directed by Departmental Representative. Both stakes should be 300mm minimum from trunk and should be placed on either side of root ball. Where trees are planted next to driveways or walkways, place one stake between tree trunk and driveway or walkway.
 - .2 Drive stakes minimum 300mm into undisturbed soil beneath rootball. Ensure stakes are secure, vertical and unsplit.
 - .3 Install 2 guying collars above lowest branch crotch a minimum 1.5m above grade.

- .4 Thread guying wire through collar tube. Twist wire to form collar and secure firmly to stake. Cut off excess wire. Ensure collar is minimum 25mm diameter larger than tree.
- .3 After tree supports have been installed, remove broken branches with clean, sharp tools.

3.5 MULCHING

- .1 Ensure soil settlement has been corrected and weeds removed prior to mulching.
- .2 Water plant material thoroughly prior to mulching.
- .3 Spread mulch to a minimum depth of 75mm.

3.6 MAINTENANCE DURING ESTABLISHMENT PERIOD

- .1 Perform following maintenance operations from time of planting until Departmental Representative's review at Substantial Performance.
 - .1 Water to maintain soil moisture conditions for optimum establishment, growth and health of plant material without causing erosion.
 - .2 For evergreen plant material: water thoroughly in late fall prior to freeze-up to saturate soil around root system.
 - .3 Remove weeds monthly.
 - .4 Replace or re-spread damaged, missing or disturbed mulch.
 - .5 Apply pesticides only in accordance with all Federal, Provincial, and Municipal regulations as and when required to control insects, fungus, and disease. Obtain product approval from Departmental Representative prior to application.
 - .6 Remove dead or broken branches from plant material.
 - .7 Keep stakes and guy wires in proper repair and adjustment.
 - .8 Apply fertilizer in early spring at manufacturer's suggested rate and as required by plant material.
 - .9 Remove and replace dead plants and plants not in healthy growing condition. Make replacements in same manner as specified for original plantings.
 - .10 Remove trunk protection, tree supports and level watering saucers at end of first growing season.

3.7 PRELIMINARY ACCEPTANCE

- .1 Plant material to be inspected by Departmental Representative at Substantial Performance review. Plant material will be accepted provided that plant material exhibits healthy growing condition and is free from disease, insects and fungal organisms.

- .2 Plant material installed in Fall will be accepted in following spring, one month after start of growing season, provided acceptance conditions outlined in 1 above, are fulfilled.
- .3 Warranty period will commence from date of Substantial Performance.

3.8 MAINTENANCE DURING WARRANTY PERIOD

- .1 Commence maintenance immediately following installation of Work and continue it until 2 years (the guarantee period) following Substantial Completion of Contract.
- .2 This maintenance will be the sole source of maintenance of the work during this period and is wholly the Contractor's responsibility.
- .3 From time of acceptance by Departmental Representative to end of warranty period, perform following maintenance operations.
 - .1 Water to maintain soil moisture conditions for optimum growth and health of plant material without causing erosion.
 - .2 For evergreen plant material: water thoroughly in late fall prior to freeze-up to saturate soil around root system.
 - .3 Reform damaged watering saucers.
 - .4 Remove weeds monthly.
 - .5 Replace or re-spread damaged, missing or disturbed mulch.
 - .6 Apply pesticides only in accordance with all Federal, Provincial, and Municipal regulations as and when required to control insects, fungus, and disease. Obtain product approval from Departmental Representative prior to application.
 - .7 Apply fertilizer in early spring at manufacturer's suggested rate and as required by plant material.
 - .8 Remove broken or hazardous branches from plant material.
 - .9 Keep stakes in proper repair and adjustment.
- .4 Notify Departmental Representative when maintenance period is completed to arrange final inspection and transfer of maintenance responsibility.
- .5 Replace plants deemed to be unacceptable by Departmental Representative. Extend warranty period for one year from date of replacement.
- .6 Include the cost of maintenance in the Total Tender Price in the Form of Tender.

3.9 CLEAN-UP

- .1 Remove materials which have spilled onto adjacent surfaces during Work of this Contract.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 31 23 33.01 - Excavating, Trenching and Backfilling.

1.2 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA B300a-11, Hypochlorites.
 - .2 ANSI/AWWA B301-10, Liquid Chlorine.
 - .3 ANSI/AWWA C509-09, Resilient-Seated Gate Valves For Water-Supply Service.
 - .4 ANSI/AWWA C800-05, Underground Service Line Valves and Fittings (Also Included: Collected Standards for Service Line Materials).
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM A 307-12, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile.
 - .2 ASTM B 62-09, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - .3 ASTM B 88M-05(2011), Standard Specification for Seamless Copper Water Tube Metric.
 - .4 ASTM C 117-04, Standard Test Method for Material Finer Than 75 μm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .5 ASTM C 136-06, Standard Method for Sieve Analysis of Fine and Coarse Aggregates..
 - .6 ASTM D 698-12, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft (600 kN-m/m³)).
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

- .4 Canadian Standards Association (CSA International)
 - .1 CSA B137 Series-09, Thermoplastic Pressure Piping Compendium.
 - .2 CSA B137.1, Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.
 - .3 CSA B137.3, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.
- .5 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .6 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act, 1992 (TDGA)
- .7 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC S701-11, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

1.3 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .3 Inform Departmental Representative of proposed source of bedding materials and provide access for sampling at least 4 weeks prior to commencing work.
- .4 Submit manufacturer's test data and certification that pipe materials meet requirements of this section at least 4 weeks prior to beginning work. Include manufacturer's drawings, information and shop drawings where pertinent.
- .5 Pipe certification to be on pipe.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide data to produce record drawings, including directions for operating valves, list of equipment required to operate valves, details of pipe material, maintenance and operating instructions in accordance with Section 01 78 10 - Closeout Submittals.

- .1 Include top of pipe, horizontal location of fittings and type, valves and valve boxes.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20 - Waste Managing and Disposal.
- .2 Dispose of unused disinfection material at official hazardous material collections site approved by Departmental Representative.

PART 2 PRODUCTS

2.1 SERVICE CONNECTIONS

- .1 Copper tubing: to ASTM B 88M type K, annealed, minimum pressure rating 1035 kPa.
- .2 Copper tubing joints: compression type suitable for 1035 kPa working pressure.

2.2 PIPE BEDDING AND SURROUND MATERIAL

- .1 Granular material Type 1 granular material in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.3 BACKFILL MATERIAL

- .1 In accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.4 PIPE DISINFECTANT

- .1 Sodium hypochlorite or calcium hypochlorite: to AWWA B300.
- .2 Liquid chlorine: to AWWA B301.

2.5 PIPE INSULATION

- .1 Extruded polystyrene insulation to CAN/ULC S701 Type 4.

PART 3 EXECUTION

3.1 DEPTH OF BURY

- .1 Water services inverts shall be a minimum depth of 1.6 m and a maximum depth of 2 m below finished grade. Where depth of bury is less than 1.6 m, insulate the service with expanded polyethylene insulation to approval of Departmental Representative.

3.2 TRENCHING

- .1 Do trenching work in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling.
- .2 Trench depth to provide cover over pipe as indicated in Section 3.2 above.
- .3 Trench alignment and depth require Departmental Representative's approval prior to placing bedding material and pipe.

3.3 GRANULAR BEDDING

- .1 Place granular bedding material in uniform lifts compatible with the compaction equipment used.
- .2 Do not place material in frozen condition.
- .3 Shape bed true to grade to provide continuous uniform bearing surface for pipe.
- .4 Shape transverse depressions in bedding as required to suit joints.
- .5 Compact each layer full width of bed to at least 95% maximum dry density to ASTM D 698.
- .6 Fill authorized or unauthorized excavation below design elevation of bottom of specified bedding in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling with compacted bedding material.

3.4 SERVICE CONNECTIONS FROM WELL

- .1 Terminate building water service inside building 250mm above slab. In coming service to cross under footing.
 - .1 Install coupling necessary for connection to building plumbing.
 - .2 If plumbing is already installed, make connection, otherwise cap or seal end of pipe 250mm above slab.
 - .3 Connect service piping to well using pitless adaptor.
- .2 Install rigid stainless steel liners in small diameter plastic pipes with compression fittings.
- .3 Place temporary location marker at ends of plugged or capped unconnected water lines.
 - .1 Each marker to consist of 38 x 89 mm stake extending from pipe end at pipe level to 600 mm above grade.
 - .2 Paint exposed portion of stake red with designation "WATER SERVICE LINE" in black.

3.5 HYDROSTATIC AND LEAKAGE TESTING

- .1 Do tests in accordance with manufacturer's recommendations.
- .2 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
- .3 Notify Departmental Representative at least 24 hours in advance of proposed tests.
- .4 Perform tests in presence of Departmental Representative.
- .5 Expel air from main by slowly filling main with potable water.
 - .1 Install corporation stops at high points in main where no air-vacuum release valves are installed.
 - .2 Remove stops after satisfactory completion of test and seal holes with plugs.
- .6 Thoroughly examine exposed parts and correct for leakage as necessary.
- .7 Apply hydrostatic test pressure of 1550kPa based on elevation of lowest point in main and corrected to elevation of test gauge, for period of 1 hour.
- .8 Examine exposed pipe, joints, fittings and appurtenances while system is under pressure.
- .9 Remove joints, fittings and appurtenances found defective and replace with new sound material and make watertight.
- .10 Repeat hydrostatic test until defects have been corrected.
- .11 Apply leakage test pressure of 1034kPa after complete backfilling of trench, based on elevation of lowest point in main and corrected to elevation of gauge, for period of 2 hours.
- .12 Define leakage as amount of water supplied from water storage tank metre in order to maintain test pressure for 2 hours.
- .13 Do not exceed allowable leakage defined by manufacturer, including lateral connections.
- .14 Locate and repair defects if leakage is greater than amount specified.

3.6 PIPE SURROUND

- .1 Upon completion of pipe laying and after Departmental Representative has inspected Work in place, surround and cover pipes as indicated.
- .2 Place surround material in uniform lifts compatible with the compaction equipment used to achieve required compaction.
 - .1 Do not dump material within 1 m of pipe.
- .3 Place layers uniformly and simultaneously on each side of pipe.
- .4 Do not place material in frozen condition.
- .5 Compact each layer from pipe invert to underside of backfill to at least 95% maximum dry density to ASTM D 698.

3.7 BACKFILL

- .1 Do not place backfill in frozen condition.
- .2 Fill excavation below bottom of specified bedding adjacent to manholes or structures with compacted Type 1 gravel to 98% corrected maximum dry density to ASTM D 698.

3.8 FLUSHING AND DISINFECTING

- .1 Flushing and disinfecting operations: witnessed by Departmental Representative.
- .2 Notify Departmental Representative at least 4 days in advance of proposed date when disinfecting operations will begin.
- .3 Flush water mains through available outlets with a sufficient flow of potable water to produce velocity of 1.5 m/s, within pipe for minimum 10 minutes, or until foreign materials have been removed and flushed water is clear.
- .4 Provide connections and pumps for flushing as required.
- .5 Open and close valves to ensure thorough flushing.

- .6 When flushing has been completed to Departmental Representative approval, introduce strong solution of chlorine as approved by Departmental Representative into water main and ensure that it is distributed throughout entire system.
- .7 Rate of chlorine application to be proportional to rate of water entering pipe.
- .8 Chlorine application to be close to point of filling water main and to occur at same time.
- .9 Operate valves and appurtenances while main contains chlorine solution.
- .10 Take water samples at service connections to test for chlorine residual.
- .11 After adequate chlorine residual not less than 50 ppm has been obtained leave system charged with chlorine solution for 24 hours.
 - .1 After 24 hours, take further samples to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.
- .12 Flush line to remove chlorine solution after 24 hours.
- .13 Measure chlorine residuals at extreme end of pipe-line being tested.
- .14 Perform bacteriological tests on water main, after chlorine solution has been flushed out.
 - .1 Take samples daily for minimum of two days.
 - .2 Should contamination remain or recur during this period, repeat disinfecting procedure.

PART 1 GENERAL

1.1 REFERENCES

- .1 Well Construction Regulations made under Section 110 of the Environment Act of the Province of Nova Scotia (NS Well Construction Regulations).

PART 2 PRODUCTS

2.1 MATERIALS

- .1 All product to be in accordance with requirements of NS Well Construction Regulations.
- .2 Well casing to be 150 mm diameter.
- .3 Minimum well depth to be 200 feet (60 m).

2.2 WELL PUMP

- .1 The water supply to the CIVIC building originates in the well. Installed in the well shall be a well pump with a minimum of 414 kPag (60psig) of pressure at building entrance.
- .2 This pump shall be of stainless steel construction and have a foot valve integrated in it. Flow of pump shall be a minimum of 0.76 l/s (12gpm) at 60 m head.
- .3 Pump Size: 1.5 HP
- .4 Pump Voltage: 208, single phase, 60hz
- .5 The well pump shall be installed as per the supplier's instructions, and at a distance of 7 m above the base of the well.
- .6 A pitless adaptor shall be used, spool or other.
- .7 A well pump shall be installed by certified pump installers only. The pump controls shall be included.
- .8 Power Cable to be provided.

- .9 Torque arrestor required.
- .10 Low level water sensor required along with pump controller.
- .11 Drop pipe: schedule 80 PVC, quick connect threaded.
- .12 Poly lift rope.
- .13 Well pump controller: CSA certified NEMA 3R enclosure wall mounted controller and magnetic line contactors. Control box to incorporate low level cut-out and restart sensing and input from pressure control switch, complete with disconnect and pressure switch for pipe mounting.
- .1 Well pump controller and well pump to be from same manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Well to be constructed, completed and yield tested as per the requirements of the NS Well Construction Regulations.
- .2 Following installation of the pumping equipment, well shall be disinfected as per NSE procedures. Following disinfection and flushing, well water shall be subjected to a complete bacterial and chemical water quality analysis allowing comparison of all parameters to those listed in the Guidelines for Canadian Drinking Water Quality.

PART 1 GENERAL

1.1 SECTION INCLUDE

- .1 Materials and installation for gravity sewers.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 20 - Waste Managing and Disposal.
- .3 Section 01 78 10 - Closeout Submittals.
- .4 Section 03 30 00 - Cast-in-Place Concrete.
- .5 Section 31 23 33.01 - Excavating Trenching and Backfilling.
- .6 Section 31 05 16 - Aggregate Materials.

1.3 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C 117-04, Standard Test Method for Material Finer Than 75 M m (No. 200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 136-06, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D 698-12e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft⁴-lbs/ft³ (600 kN-m/m³)).
 - .4 ASTM D 3034-14, Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

- .3 Canadian Standards Association (CSA International)
 - .1 CSA B 1800-11, Thermoplastic Nonpressure Pipe Compendium (consist of B181.0, B181.1, B181.2, B181.3, B181.5, B182.1, B182.2, B182.4, B182.6, B182.7, B182.8 and B182.11).
 - .2 CSA A3000-08, Cementitious Materials Compendium (consist of A3001, A3002, A3003, A3004 and A3005). Includes updates No. 1 (2009), update No. 2 (2010), update No. 3 (2011).

1.4 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Inform Departmental Representative at least 2 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling.
- .3 Ensure certification is marked on pipe.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer recommendations.

PART 2 PRODUCTS

2.1 PLASTIC PIPE

- .1 Type PSM Polyvinyl Chloride (PVC): to CSA-B182.2.
 - .1 Standard Dimensional Ratio (SDR): 28 for pipe equal to or less than 150mm in diameter, 35 for a pipe greater than 150mm diameter.
- .2 Locked-in gasket and integral bell system.
- .3 Nominal lengths: 6 m.

2.2 SERVICE CONNECTIONS

- .1 Type PSM Poly (Vinyl) Chloride: to CSA-B182.2.
- .2 Plastic pipe: to CSA B182.1, with push-on joints.

2.3 CEMENT MORTAR

- .1 Portland cement: to A3000.
- .2 Mix mortar one part by volume of cement to two parts of clean, sharp sand mixed dry.
 - .1 Add only sufficient water after mixing to give optimum consistency for placement.
 - .2 Do not use additives.
 - .3

2.4 PIPE BEDDING AND SURROUND MATERIALS

- .1 As indicated and in accordance with Section 31 23 33.01 - Excavating, Trenching, and Backfilling.
- .2 Concrete mixes and materials for cradles, encasement, supports to Section 03 30 00 - Cast-in-Place Concrete.

2.5 BACKFILL MATERIAL

- .1 As indicated and in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Clean and dry pipes and fittings before installation.
- .2 Obtain Departmental Representative's approval of pipes and fittings prior to installation.

3.2 TRENCHING

- .1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Do not allow contents of any sewer or sewer connection to flow into trench.
- .3 Trench alignment and depth require approval of Departmental Representative prior to placing bedding material and pipe.

3.3 GRANULAR BEDDING

- .1 Place bedding in unfrozen condition.
- .2 Place granular bedding materials in uniform layer to depth as indicated.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
 - .1 Do not use blocks when bedding pipe.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 100% Standard Proctor Density to ASTM D 698.

3.4 INSTALLATION

- .1 Lay and join pipes in accordance with manufacturer's recommendations and to approval of Departmental Representative.
- .2 Handle pipe using methods approved by Departmental Representative.
 - .1 Do not use chains or cables passed through rigid pipe bore so that weight of pipe bears upon pipe ends.
- .3 Lay pipes on prepared bed, true to line and grade, with pipe invert smooth and free of sags or high points.
 - .1 Ensure barrel of each pipe is in contact with shaped bed throughout its full length.
- .4 Begin laying at outlet and proceed in upstream direction with socket ends of pipe facing upgrade.
- .5 Do not exceed maximum joint deflection recommended by pipe manufacturer.
- .6 Do not allow water to flow through pipe during construction, except as may be permitted by Departmental Representative.
- .7 Whenever Work is suspended, install removable watertight bulkhead at open end of last pipe laid to prevent entry of foreign materials.
- .8 Install plastic pipe and fittings in accordance with CSA B182.11.
- .9 Pipe jointing:
 - .1 Install gaskets in accordance with manufacturer's recommendations.
 - .2 Support pipes with hand slings or crane as required to minimize lateral pressure on gasket and maintain concentricity until gasket is properly positioned.
 - .3 Align pipes before joining.
 - .4 Maintain pipe joints free from mud, silt, gravel and other foreign material.
 - .5 Avoid displacing gasket or contaminating with dirt or other foreign material. Gaskets so disturbed shall be removed, cleaned and lubricated and replaced before joining is attempted.
 - .6 Complete each joint before laying next length of pipe.
 - .7 Minimize joint deflection after joint has been made to avoid joint damage.
 - .8 At rigid structures, install pipe joints not more than 1.20 m from side of structure.

- .9 Apply sufficient pressure in making joints to ensure that joint is complete as outlined in manufacturer's recommendations.
- .10 When stoppage of Work occurs, block pipes as directed by Departmental Representative to prevent creep during down time.
- .11 Cut pipes as required for special inserts, fittings or closure pieces as recommended by pipe manufacturer, without damaging pipe or its coating and to leave smooth end at right angles to axis of pipe.
- .12 Make watertight connections to septic tanks and pump chamber.
 - .1 Pipe to structure connecting gaskets to manufacturers specifications and recommendations;
 - .2 Use shrinkage compensating grout only when suitable gaskets are not available.

3.5 PIPE SURROUND

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated.
 - .1 Leave joints and fittings exposed until field testing is completed.
- .3 Hand place surround material in uniform layers not exceeding 150 mm compacted thickness as indicated.
 - .1 Do not dump material within 0.25 m of pipe.
- .4 Place layers uniformly and simultaneously on each side of pipe.
- .5 Compact each layer from pipe invert to mid height of pipe to at least 100% Standard Proctor Density to ASTM D 698.
- .6 Compact each layer from mid height of pipe to underside of backfill to at least 98% Standard Proctor Density to ASTM D 698.
- .7 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.6 BACKFILL

- .1 Place backfill material in unfrozen condition.

- .2 Place backfill material, above pipe surround in uniform layers not exceeding 200 mm compacted thickness up to grades as indicated.
- .3 Under paving and walks, compact backfill to at least 100% Standard Proctor Density to ASTM D 698.
 - .1 In other areas, compact to at least 98% Standard Proctor Density to ASTM D 698.
- .4 Place backfill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.7 SERVICE CONNECTIONS

- .1 Install pipe to CSA B182.11 and manufacturer's instructions and specifications.
- .2 Maintain grade as indicated.
- .3 Service connections to main sewer as indicated.
 - .1 Do not use break-in and mortar patch-type joints.
- .4 Make up required horizontal and vertical bends from 45 degrees bends or less, separated by straight section of pipe with minimum length of four pipe diameters.
 - .1 Use long sweep bends where applicable.
- .5 Plug service laterals with water tight caps or plugs as approved by Departmental Representative.
- .6 Place location marker at ends of plugged or capped unconnected sewer lines.
 - .1 Each marker: 38 x 89 mm stake extending from pipe end at pipe level to 0.6 m above grade.
 - .2 Paint exposed portion of stake red with designation SAN SWR LINE in black.

3.8 FIELD TESTING

- .1 If water used for flushing or testing is obtained from a potable water supply, the potable water supply is to be continuously separated from the service being flushed or tested by an air gap or a level or protection equal to or greater than that provided by a double check valve backflow prevention device.

- .2 Test each section of sewer. A section is the length of pipe between successive structures or termination points, including service connections to the street line or termination point.
- .3 Provide labour, equipment and materials required to perform testing.
- .4 Notify Departmental Representative at least 24 hours in advance of all proposed tests. Perform tests in presence of Departmental Representative.
- .5 Flush sewers and related appurtenances to remove foreign materials.
- .6 Install watertight bulkheads in suitable manner to isolate test section from rest of pipeline.
- .7 Exfiltration test:
 - .1 Fill test section with water to displace air in line. Maintain under nominal head for 24 hours to ensure absorption in pipe wall is complete before test measurements are begun.
 - .2 Immediately prior to test period add water to pipeline until there is head of 1 m over interior crown of pipe measured at highest point of test section or water in manhole is 1 m above static ground water level, whichever is greater.
 - .3 Duration of exfiltration test: 2 hours.
 - .4 Water loss at end of test period: not to exceed maximum allowable exfiltration over any section of pipe between manholes.
- .8 Infiltration test:
 - .1 Conduct infiltration test in lieu of exfiltration test where static ground water level is 750 mm or more above top of pipe measured at highest point in line to be used.
 - .2 Do not interpolate a head greater than 750 mm to obtain an increase in allowable infiltration rate.
 - .3 Install watertight plug at upstream end of pipeline test section.
 - .4 Discontinue pumping operations for at least 3 days before test measurements are to begin and during this time, keep thoroughly wet at least one third of pipe invert perimeter.
 - .5 Prevent damage to pipe and bedding material due to flotation and erosion.
 - .6 Place 90 degrees V-notch weir, or other measuring device approved by Departmental Representative in invert of sewer at each structure.
 - .7 Measure rate of flow over minimum of 1 hour, with recorded flows for each 5 min interval.
- .9 Infiltration and exfiltration: not to exceed following limits in L per hour per 100 m of pipe, including service connections.

Nominal Pipe diameter in mm	Asbestos-Cement Pipe	Concrete or Vitrified Clay Pipe
100	3.88	25.5
125	4.62	30.0
150	5.51	34.0
200	7.45	41.5
250	9.39	49.5
300	11.33	56.5
350	13.27	63.5
400	14.91	70.0
450	16.84	76.0
500	18.78	81.5
550	20.72	87.0
600	22.80	92.5
700	26.53	102.0
800	30.11	110.5
900	33.69	118.0
1000	37.56	124.5
1100	41.29	130.0
1200	45.01	135.0

- .10 Leakage: not to exceed following limits in litres per hour per mm of diameter per 100 m of sewer including service connections:
- .1 Exfiltration, based on 600 mm head: 0.175 L.
 - .2 Infiltration: 0.150 L.
- .11 Repair and retest sewer line as required, until test results are within limits specified.
- .12 Repair visible leaks regardless of test results.
- .13 Television and photographic inspections:
- .1 Carry out inspection of installed sewers by television camera, photographic camera or by other related means. Contractor to carry out and bear all costs associated with CCTV inspections.
 - .2 Provide means of access to permit Departmental Representative to do inspections.

PART 1 GENERAL

1.1 REFERENCES

- .1 American National Standards Institute/American Water Works Association (ANSI/AWWA)
 - .1 ANSI/AWWA C900-07, Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 Inch-12 Inch (100 mm-300 mm), for Water Distribution.
- .2 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C 136-06, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .2 ASTM C 117-04, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .3 ASTM D 698-07a, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort ((12,400 ft-lbf/ft³) (600kN-m/m³)).
 - .4 ASTM D1785-12, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves Testing, Woven Wire, Metric.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA B137 Series-09, Thermoplastic Pressure Piping Compendium.
 - .1 CSA B137.3, Rigid Polyvinyl Chloride (PVC) Pipe for Pressure Applications.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide Departmental Representative at least 4 weeks prior to beginning Work, with proposed source of bedding materials and provide access for sampling.

- .3 Submit manufacturer's test data and certification at least 2 weeks prior to beginning Work in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Certification to be marked on pipe.

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 20 - Waste Managing and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Separate for reuse and recycling and place in designated containers Steel, Metal, Plastic waste in accordance with Waste Management Plan.
- .5 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .6 Divert unused concrete materials from landfill to local facility as approved by Departmental Representative.
- .7 Divert unused aggregate materials from landfill to facility for reuse as approved by Departmental Representative.
- .8 Do not dispose of unused asbestos cement pipe in accordance with regulations governing disposal of hazardous materials.
- .9 Place materials defined as hazardous or toxic in designated containers.
- .10 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.
- .11 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Polyvinyl Chloride (PVC) Pressure Pipe: to CSA-B137.3, ASTM D1785.
 - .1 Schedule 40, solvent welded joints, except where threaded joints are required.
 - .2 Solvent cement for socket joints shall comply to ASTM D2566 and F656.

2.2 PIPE BEDDING AND SURROUND MATERIALS

- .1 As indicated and as in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Concrete mixes and materials required for bedding cradles, encasement, supports, thrust blocks: to Section 03 30 00 - Cast-in-Place Concrete.

2.3 BACKFILL MATERIAL

- .1 As indicated.

PART 3 EXECUTION

3.1 PREPARATION

- .1 Pipes and fittings to be clean and dry.
- .2 Prior to installation, obtain Departmental Representative's approval of pipes and fittings.

3.2 TRENCHING

- .1 Do trenching Work, in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Trench alignment and depth require approval from Departmental Representative prior to placing bedding material or pipe.

3.3 GRANULAR BEDDING

- .1 Place granular bedding in unfrozen condition.
- .2 Place granular bedding material in uniform layers not exceeding 150 mm compacted thickness to depth as indicated.
- .3 Shape bed true to grade and to provide continuous, uniform bearing surface for pipe.
- .4 Shape transverse depressions as required to suit joints.
- .5 Compact each layer full width of bed to at least 100% corrected maximum dry density maximum density to ASTM D 698.
- .6 Fill excavation below design elevation of bottom of specified bedding with compacted bedding material.

3.4 INSTALLATION

- .1 Lay pipes in accordance with manufacturer's recommendations.
- .2 Join pipes in accordance with manufacturer's recommendations.
- .3 Avoid damage to machined ends of pipes in handling and moving pipe.
- .4 Maintain grade and alignment of pipes.
- .5 Align pipes carefully before jointing.
- .6 Do not exceed maximum joint deflection recommended by pipe manufacturer.

- .7 Support pipe firmly over entire length, except for clearance necessary at couplings. Do not use blocks to support pipe.
- .8 Keep pipe and pipe joints free from foreign material.
- .9 Apply restraint to pipe to ensure that joints when completed are held in place, by tamping fill material under and alongside pipe, or otherwise as approved by Departmental Representative.
- .10 When stoppage of Work occurs, block pipe as directed by Departmental Representative to prevent creep during downtime.
- .11 Prior to solvent welding, remove fittings and couplings from packaging and expose to air for at least 1 hour.
- .12 Do not apply solvent cement to wet surfaces.

3.5 PIPE SURROUND

- .1 Place surround material in unfrozen condition.
- .2 Upon completion of pipe laying, and after Departmental Representative has inspected pipe joints, surround and cover pipes as indicated. Leave joints and fittings exposed until field testing is completed.
- .3 Hand place surround material in uniform layers simultaneously on each side of pipe not exceeding 150 mm compacted thickness as indicated. Do not dump material within of pipe.
- .4 Compact each layer from pipe invert to mid height of pipe to at least 100% corrected maximum dry density.
- .5 Compact each layer from mid height of pipe to underside of backfill to at least 98% corrected maximum dry density.
- .6 When field test results are acceptable to Departmental Representative, place surround material at pipe joints.

3.6 BACKFILL

- .1 Place backfill material in unfrozen condition.

- .2 Place backfill material, above pipe surround in uniform layers not exceeding 150 mm compacted thickness up to grades as indicated.
- .3 Under paving and walks, compact backfill to at least 100 % corrected maximum dry density. In other areas, compact to at least 98% corrected maximum dry density.
- .4 Place unshrinkable fill in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

3.7 FIELD TESTING OF FORCE MAIN

- .1 Testing of force main to be carried out under supervision in presence of Departmental Representative.
- .2 Strut and brace caps, bends and tees, to prevent movement when test pressure is applied.
- .3 Expel air from force main, by slowly filling main with water. Drill and tap high points and install suitable cocks to vent air and to be shut when pressure is applied. Remove cocks after satisfactory completion of test and seal holes with tight fitting plugs.
- .4 Apply hydrostatic test pressure based on elevation of lowest point in line and corrected to elevation of test gauge for hydrostatic test and for leakage test.
- .5 Apply pressure for 1h for pressure test and 2h for leakage test.
- .6 Examine exposed pipe, joints and fittings while system is under pressure.
- .7 Remove defective joints, pipe and fittings and replace with new sound material.
- .8 Define leakage as amount of water supplied from water storage tank in order to maintain test pressure for 2h.
- .9 Do not exceed allowable leakage as defined in ANSI/AWWA C600.
- .10 Locate and repair defects if leakage is greater than amount specified.
- .11 Repeat test until leakage is within specified allowance for full length of force main.
- .12 Complete backfill.
- .13 Repeat test after completing backfill. Locate and repair defects and backfill. Repeat tests, repairs and backfills as needed until leakage is less than amount specified.

PART 1 GENERAL

1.1 MEASUREMENT PROCEDURES

- .1 Septic tank and effluent pump chamber are included in lump sum price.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C 117-04 Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 136-06 Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D 698-12e1, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association, (CSA International)
 - .1 CAN/CSA-A23.1/A23.2-09 (June 2001), Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
 - .2 CAN/CSA-A23.4/A251-09, Precast Concrete-Materials and Construction/Qualification Code for Architectural and Structural Precast Concrete Products.
 - .3 CAN/CSA-B66-05, Prefabricated Septic Tanks and Sewage Holding Tanks.

1.3 DESIGN REQUIREMENTS

- .1 Design precast concrete septic tank and effluent pump chamber in accordance with CAN/CSA-B66, and to carry handling stresses and indicated service loads.

- .2 Septic tank to have a minimum total working capacity of 4,635 L.
- .3 Effluent pump chamber to have a minimum working capacity of 2040 L.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures and in accordance with CAN/CSA-A23.4/A251.
- .2 Shop drawings to indicate:
 - .1 Design calculations for items designed by manufacturer.
 - .2 Tables and bending diagrams of reinforcing steel.
 - .3 Camber.
 - .4 Formwork.
 - .5 Finishing schedules.
 - .6 Methods of handling and erection.
 - .7 Storage facilities.
 - .8 Openings, sleeves, inserts and related reinforcement.
- .3 Each drawing submission shall bear stamp and signature of qualified professional engineer registered or licensed in Province of Nova Scotia, Canada.

1.5 QUALIFICATIONS

- .1 Manufacturers of precast concrete elements shall be certified by CSA as meeting requirements of CAN/CSA-A23.4/A251, for Category SC SP products.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling in accordance with Section 01 74 20 - Waste Managing and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

- .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Divert unused concrete materials from landfill to local facility as approved by Departmental Representative.
- .5 Divert unused aggregate materials from landfill to facility for reuse as approved by Departmental Representative.

PART 2 PRODUCTS

2.1 CONCRETE MIXES AND MATERIALS

- .1 Concrete mixes and materials: to CAN/CSA-B66 and CAN/CSA-A23.1/A23.2.

2.2 MANUFACTURE

- .1 Manufacture units in accordance with CAN/CSA-A23.4/A251, except where specified otherwise.

2.3 FINISHES

- .1 Finish tanks to commercial grade to CAN/CSA-A23.4/A251.

2.4 ACCESS

- .1 Provide access holes to surface to facilitate cleaning, inspection and access to pumping equipment. Provide locking covers at surface.

2.5 TANK BEDDING AND SURROUND MATERIAL

- .1 Granular material to Section 31 05 16 - Aggregate Materials and following requirements:

- .1 Crushed or screened stone, gravel or sand.
.2 Gradations to be within limits specified when tested to ASTM C 136 and ASTM C 117. Sieve sizes to CAN/CGSB-8.1 CAN/CGSB-8.2.
.3 Table

<u>Sieve Designation</u>	<u>% Passing</u>
200 mm	-
75 mm	-
50 mm	-
37.5 mm	-
25 mm	-
19 mm	-
12.5 mm	100
9.5 mm	-
4.75 mm	80-100
2.00 mm	50- 90
0.425 mm	10- 50
0.180 mm	-
<u>0.075 mm</u>	<u>0- 10</u>

2.6 BACKFILL MATERIAL

- .1 As indicated in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.

2.7 MODULAR WALL SEALS

- .1 Provide modular wall seals

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Place bedding and surround material in unfrozen condition.
- .2 Do excavation in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .3 Place tank bedding material in accordance with details as indicated. Compact to 100% corrected maximum dry density maximum dry density to ASTM D 698.
- .4 Make inlet and outlet joints of septic tank watertight, using modular wall seals.
- .5 Conduct leakage test on septic tank in presence of Departmental Representative, before backfilling. Fill tank to level of effluent pipe, and allow to stand for 24 hours. Allowable leakage is zero.
- .6 Do backfilling in accordance with Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .7 Compact to 98% corrected maximum dry density maximum dry density to ASTM D 698.

PART 1 GENERAL

1.1 MEASUREMENT PROCEDURES

- .1 Effluent disposal field is included in lump sum price.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
- .1 ASTM C 117-04, Standard Test Method for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.
 - .2 ASTM C 136-06, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
 - .3 ASTM D 422-63(2007)e1, Standard Method for Particle-Size Analysis of Soils.
 - .4 ASTM-C33-03, Standard Specification for concrete aggregate.
- .2 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.
 - .2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.
- .3 Canadian Standards Association (CSA International)
- .1 CSA B137 Series-09, Thermoplastic Pressure Piping Compendium.
 - .1 CSA B137.1-02, Polyethylene Pipe, Tubing, and Fittings for Cold-Water Pressure Services.
 - .2 CSA B1800-11, Plastic Non-pressure Pipe Compendium - B1800 Series.
 - .1 CSA B182.2-02, PVC Sewer Pipe and Fittings (PSM Type).
 - .3 CSA A23.1-09 Concrete Materials and Methods of Concrete Construction.
- .4 Nova Scotia Department of Environment On-Site Sewage Disposal Systems Technical Guidelines (June 2013)

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit to Departmental Representative copy of certification or licence of approved installers.

1.4 QUALITY ASSURANCE

- .1 Use licenced installers who comply with local authority having jurisdiction.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .2 Divert unused concrete materials from landfill to local quarry facility as approved by Departmental Representative.
- .3 Divert unused aggregate materials from landfill to quarry facility for reuse as approved by Departmental Representative.
- .4 Divert unused geotextiles from landfill to plastic recycling facility for disposal approved by Departmental Representative.

PART 2 PRODUCTS

2.1 GRANULAR MATERIALS

- .1 Granular material to Section 31 05 16 - Aggregate Materials and following requirements:
 - .1 Filter Sand shall be either: a manufactured sand that meets current ASTM-33 or CSA A23.1 specifications or a naturally occurring or manufactured sand having a permeability, as placed on site, between 0.0001 and 0.0005 m/s as determined by the falling head permeability test and have a maximum particle size corresponding to the appropriate ASTM-33 or CSA A23.1 specification for fine aggregate.

- .2 Crushed gravel shall be a clean, washed or screeded crushed rock or gravel free of soft or friable material; 98% (by weight) shall pass a 35 mm screen and 98% (by weight) shall be retained on a 12 mm screen.

2.2 IMPERVIOUS MATERIAL

- .1 Material to have Plasticity Index not less than 15% as measured to ASTM D 4318.
- .2 Material to have minimum of 50% of particles finer than 0.075 mm as measured to ASTM D 422.

2.3 GEOTEXTILE COVER

- .1 The geotextile cover shall:
 - .1 Be a non-degradable man-made fibre such as polyester or polypropylene
 - .2 Have an opening size less than 700 microns
 - .3 Have a permeability greater than 0.001 m/s
- .2 Specification normally met with a light weight (50 g/m² or more) non-woven (ie felted, needle punched or heat bonded fibre) fabric or proprietary geotextile.
- .3 See 31 32 19.01 – Geotextiles for additional information.

2.4 PIPE FOR DISPOSAL FIELDS

- .1 Straight PVC pipe and fittings to CSA-B137. Perforated or unperforated as indicated on the drawings.

2.5 SOURCE QUALITY CONTROL

- .1 If requested, provide Departmental Representative with 2 certified copies of factory tests of pipe material.

2.6 EFFLUENT PUMP SYSTEM

- .1 Effluent pump system to consist of fully automatic single point connection system including but not limited to: submersible effluent pump, float level control, high level alarm, control panel complete with audible and visual alarm indicator, electrical and control wiring from control panel to pump, EYS seal(s), connectors, support and raceway to provide a complete system to operate as described on drawings 103 and 105. All components to be supplied as single package unit.
- .2 All components to be CSA approved
- .3 All systems to be installed according to the Canadian Plumbing Code and the Canadian Electrical Code requirements, as well as per Division 26 requirements.
- .4 Effluent pump and control components located in pump chamber shall be approved for hazardous locations, Class 1 Zone 2 Group IIA & IIB, T3.
- .5 Effluent pump to be a submersible pump capable of passing 19 mm dia. solids. 4/10hp, 115V, 60Hz; 150 L/min @ 6.4m; 38mm S.W. discharge; min. 6.1m cord length. Acceptable Product: Myers ME40 Series or approved equal.

PART 3 EXECUTION

3.1 DISPOSAL FIELD INSTALLATION

- .1 Rough grade to depths as indicated.
- .2 Place sand material in unfrozen condition as indicated.
- .3 Leaching bed fill material (imported filter material) to have percolation rate of 10 min/cm and be pre-approved by Departmental Representative prior to its mass importation to site.
- .4 Upon completion of placement of leaching bed fill, Departmental Representative to conduct 3 in situ percolation tests in sand mound prior to proceeding with bed construction.
- .5 Obtain Departmental Representative's approval to operate construction equipment across disposal field.
- .6 Place minimum 100 mm deep of filter sand under distribution pipe at width indicated.

- .7 Place minimum 125 mm deep of crushed gravel under distribution pipe at the width indicated.
- .8 Install pressure header between pumping chamber and leaching bed. Header to be constructed as per 33 34 00 – Sanitary Utility Sewerage Force Mains.
- .9 Distribution Header: provide perforations as indicated. Set distribution header in disposal trench as indicated.
- .10 Connect lengths and place distribution pipe on stone material as indicated and cover with minimum 75 mm of stone material to width indicated.
- .11 Place geotextile over stone as indicated.
- .12 Connect distribution pipe to header.
- .13 Cap or plug free ends of distribution lines.
- .14 Maintain pipe elevations within 5 mm of inverts indicated.
- .15 Do not cover disposal field area until pipe grade and alignment have been approved by Departmental Representative and authority having jurisdiction.
- .16 Cover disposal field as indicated. Material to be approved by Departmental Representative. Do not compact. Overfill to allow for settlement.
- .17 Grade areas surrounding disposal field bed as indicated, to provide for diversion of surface run off waters.

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for pipe culverts.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 20 – Waste Managing and Disposal.
- .3 Section 03 30 00 - Cast-in-Place Concrete.
- .4 Section 31 05 16 - Aggregate Materials.
- .5 Section 31 23 33.01 - Excavating, Trenching and Backfilling.

1.3 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C14M-14, Standard Specification for Concrete Sewer, Storm Drain and Culvert Pipe (Metric).
 - .2 ASTM C76M-14, Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe (Metric).
 - .3 ASTM C 144-11, Standard Specification for Aggregate for Masonry Mortar.
 - .4 ASTM C443M-11, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).
 - .5 ASTM D 1248-12, Standard Specification for Polyethylene Plastics Extrusion Materials For Wire and Cable.
 - .6 ASTM F 667-12, Standard Specification for Large Diameter Corrugated Polyethylene Pipe and Fittings.
- .2 Canadian General Standards Board (CGSB)
- .3 Canadian Standards Association (CSA International)

- .1 CAN/CSA-A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005) (Includes Update #4, June 2006).
 - .1 CSA A8/A5/A362-93, Portland Cement.
 - .2 CAN/CSA A257 SERIES-09 Standards for Concrete Pipe.

1.4 SUBMITTALS

- .1 Submit samples in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Inform Departmental Representative at least 4 weeks prior to beginning Work, of proposed source of bedding materials and provide access for sampling.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Manufacturer requirements and recommendations.

PART 2 PRODUCTS

2.1 CONCRETE PIPE

- .1 Reinforced concrete pipe: to CAN/CSA-A257.2 diameter as indicated, strength classification 65D.
- .2 Rubber gaskets for joints: to CAN/CSA A257 SERIES-09 and ASTM C443M-07.
- .3 Cement mortar joint filler:
 - .1 Portland cement: to ASTM C150.
 - .2 Sand: to ASTM C778.
 - .3 Mortar: one part by volume of cement to two parts of clean, sharp sand mixed dry. Add sufficient water after mixing to give optimum consistency for hand application.

2.2 END TREATMENTS

- .1 Rip-rap: as indicated.

2.3 GRANULAR BEDDING AND BACKFILL

- .1 Granular bedding and backfill material as indicated and to Section 31 05 16 - Aggregate Materials and Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Concrete mixes and materials for bedding, cradles, encasement, supports: to Section 03 30 00 - Cast-in-Place Concrete.

PART 3 EXECUTION

3.1 TRENCHING

- .1 Do trenching Work in accordance with Section 31 23 33.01 - Excavating Trenching and Backfilling.
- .2 Obtain Departmental Representative's approval of trench line and depth prior to placing bedding material or pipe.

3.2 BEDDING

- .1 Dewater excavation, as necessary, to allow placement of culvert bedding in dry condition.
- .2 Place minimum thickness of 200 mm of approved granular material on bottom of excavation and compact to minimum 100% Standard Proctor Corrected Maximum Dry Density to ASTM D698.
- .3 Shape bedding to fit lower segment of pipe exterior so that width of at least 50% of pipe diameter is in close contact with bedding and to camber as indicated or as directed by Departmental Representative, free from sags or high points.
- .4 Place bedding in unfrozen condition.

3.3 LAYING CONCRETE PIPE CULVERTS

- .1 Begin at downstream end of culvert with flanged end of first pipe section facing upstream.
- .2 Ensure barrel of each pipe is in contact with shaped bed throughout its length.
- .3 Do not allow water to flow through pipes during construction except as permitted by Departmental Representative.

3.4 JOINTS: CONCRETE PIPE CULVERTS

- .1 Joints may be made with rubber gaskets, bituminous jointing compound or Portland cement mortar where specific joint type is not otherwise specified.
 - .1 Rubber gasket joints:
 - .1 Install to manufacturer's recommendations.
 - .2 Ensure that tapered ends are fully entered into flanged ends.
 - .2 Bituminous filled joint:
 - .1 Make joint with excess of filler to form continuous bead around outside of pipe and finish smooth on inside.
 - .3 Mortar joints:
 - .1 Prepare mortar as specified herein.
 - .2 Clean pipe ends and wet with water before joint is made.
 - .3 Place mortar in lower half of flanged end of pipe section in place.
 - .4 Apply mortar to upper half of tapered end of pipe section being installed.
 - .5 Join pipe ends and force joint up tight, taking care to ensure inner surfaces of abutting pipe sections are flush and even.
 - .6 Clean inside of pipe and annular space between ends of pipes after each joint is made.
 - .7 Fill joint with mortar and finish smooth and even.
 - .8 For pipes 800 mm or less diameter, fill joints before mortar in joints has set.
 - .9 For pipes over 800 mm diameter, postpone filling joint until backfilling has been completed. Re-clean joints before applying mortar.

3.5 END TREATMENT

- .1 Install rip-rap as indicated or as directed by Departmental Representative.
- .2 Obtain approval of Departmental Representative of culvert installation prior to installation of any end treatments.

3.6 NSTIR REQUIREMENTS

- .1 Any requirements by Nova Scotia Transportation and Infrastructure Renewal contained in the Work within Highway Right-of-Way permit shall take precedence.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 20 – Waste Managing and Disposal.
- .3 Section 03 30 00 – Cast-In-Place Concrete.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM D 1056-07, Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- .2 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1-04, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.
 - .2 CSA G30.3-M1983 (R1998), Cold-Drawn Steel Wire for Concrete Reinforcement.
 - .3 CSA G30.5-M1983 (R1998) Welded Steel Wire Fabric for Concrete Reinforcement.
 - .4 CAN/CSA-G30.18-09, Billet-Steel Bars for Concrete Reinforcement.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20 - Waste Managing and Disposal.

- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material for recycling in accordance with Waste Management Plan.
- .4 Divert unused metal materials from landfill to metal recycling facility as approved by Departmental Representative.
- .5 Divert unused and broken concrete materials from landfill to local facility as approved by Departmental Representative.
- .6 Divert unused aggregate materials from landfill to facility for reuse as approved by Departmental Representative.
- .7 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 PRODUCTS

2.1 PVC DUCTS

- .1 PVC ducts, type EB1, encased in reinforced concrete.
 - .1 Utilization of PVC split ducts is not permitted. Acceptable Products
 - .1 Grace Construction Products "EuroWax"
 - .2 Form release agent; architectural concrete formwork, marble-like appearance: non-staining release agent for void-free, and smooth release of concrete, produces high quality architectural concrete finishes with a marble-like appearance.
 - .1 Acceptable Products
 - .1 Grace Construction Products "Marb-A-Like"
 - .3 Joint tape: non-staining, water impermeable, self-release, reinforced to prevent fin formation.

2.2 PVC DUCT FITTINGS

- .1 Rigid PVC translucent pushfit type couplings, bell end fittings, plugs, caps, adaptors as required to make complete installation.

- .2 Expansion joints.
- .3 Rigid PVC 5 degree angle couplings.

2.3 CONCRETE FOR DUCTBANK

- .1 Refer to Section 03 30 00 – Cast-In-Place Concrete.

2.4 WARNING TAPE

- .1 4 mil polyethylene warning 75 mm in width. Text on tape to read "CAUTION BURIED ELECTRICAL LINE BELOW".

2.5 MARKERS

- .1 Concrete type cable markers: 600 x 600 x 100 mm, with words:"DUCT BANK" impressed in top surface, with arrows to indicate change in direction of duct bank.

PART 3 EXECUTION

3.1 INSTALLATION

- .1 Install underground duct banks including formwork.
- .2 Build duct bank on undisturbed soil or on well compacted granular fill not less than 150 mm thick, compacted to 100% of standard proctor density.
- .3 Open trench completely between points to be connected before ducts are laid and ensure that no obstructions will necessitate change in grade of ducts.
- .4 Prior to laying ducts, construct "mud slab" not less than 75 mm thick complete with 6 mil polyethylene sheet barrier.

- .5 Install ducts at elevations and with slope as indicated and minimum slope of 1 to 400.
- .6 Install base spacers at maximum intervals of 1.5 m levelled to grades indicated for bottom layer of ducts.
- .7 Lay PVC ducts with configuration and reinforcing as indicated with preformed interlocking, rigid plastic intermediate spacers to maintain spacing between ducts at not less than 25 mm horizontally and vertically. Stagger joints in adjacent layers at least 150 mm and make joints watertight. Encase duct bank with minimum 50 mm thick concrete cover.
- .8 Make transpositions, offsets and changes in direction using 5 degree bend sections, do not exceed a total of 20 degree with duct offset.
- .9 Use bell ends at duct terminations.
- .10 Use conduit to duct adapters when connecting to conduits.
- .11 Terminate duct runs with duct coupling set flush with end of concrete envelope when dead ending duct bank for future extension.
- .12 Cut, ream and taper end of ducts in field in accordance with manufacturer's recommendations, so that duct ends are fully equal to factory-made ends.
- .13 Allow concrete to attain 50% of its specified strength before backfilling.
- .14 Use anchors, ties and trench jacks as required to secure ducts and prevent moving during placing of concrete. Tie ducts to spacers with twine or other non-metallic material. Remove weights or wood braces before concrete has set and fill voids.
- .15 Clean ducts before laying. Cap ends of ducts during construction and after installation to prevent entrance of foreign materials.
- .16 Immediately after placing of concrete, pull through each duct steel mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Avoid disturbing or damaging ducts where concrete has not set completely. Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .17 In each duct install pull rope continuous throughout each duct run with 3 m spare rope at each end.

3.2 MARKERS AND WARNING TAPE

- .1 Mark location of duct runs under hard surfaced areas not terminating in manhole with railway spike driven flush in edge of pavement, directly over run. Place concrete duct marker at ends of such duct runs. Construct markers and install flush with grade.
- .2 Mark ducts every 150 m along straight runs and changes in direction.
- .3 Where markers are removed to permit installation of additional duct, reinstall existing markers.
- .4 Lay concrete markers flat and centered over duct with top 25 mm above earth surface.
- .5 Provide drawings showing locations of markers.
- .6 Install warning tape over full length of underground duct banks and manholes.

3.3 INSPECTION

- .1 Inspection of duct will be carried out by Departmental Representative prior to placing. Placement of concrete and duct cleanout to be done when Departmental Representative present.

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 20 – Waste Managing and Disposal.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No. 211.1-06 Rigid Types EB1 and DB2/ES2 PVC Conduit.

1.3 SUBMITTALS

- .1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit WHMIS MSDS - material Safety Data Sheets acceptable to Labour Canada and Health and Welfare Canada for solvent cement.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 20 - Waste Managing and Disposal.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastic, polystyrene and corrugated cardboard packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.
- .4 Place materials defined as hazardous or toxic in designated containers.
- .5 Fold up metal banding, flatten and place in designated area for recycling.
- .6 Do not dispose of preservative treated wood through incineration.

- .7 Do not dispose of preservative treated wood with other materials destined for recycling or reuse. Dispose of treated wood, and pieces, wood scraps and sawdust at sanitary landfill as approved by Departmental Representative.
- .8 Dispose of unused wood preservative material at official hazardous material collections site. Do not dispose of unused preservative material into sewer system, into streams, lakes, onto ground or in other location where they will pose health or environmental hazard.
- .9 Dispose of unused solvent cement at an official hazardous material collections sites as approved by Departmental Representative. Do not dispose of unused solvent cement into sewer system, into streams, lakes, onto ground or in other location where they will pose health or environmental hazard.

PART 2 PRODUCTS

2.1 PVC DUCTS AND FITTINGS

- .1 Rigid PVC duct: to CSA C22.2 No. 211.1-06 Rigid Type DB2/ES2, with moulded fittings, for direct burial expanded flange ends. Nominal length: 3 m plus or minus 12 mm.
- .2 Rigid PVC bends, couplings, reducers, bell end fittings, plugs, caps, adaptors same product material as duct, to make a complete installation.
- .3 Rigid PVC 90 degrees and 45 degrees bends.
- .4 Rigid PVC 5 degree angle couplings.
- .5 Expansion joints every 50 m and as required.
- .6 Utilization of PVC split ducts is not permitted.

2.2 SOLVENT WELD

- .1 Solvent cement for PVC duct joints.

- .2 6 mm Stranded nylon pull rope tensile strength 5 kN.

2.3 WOOD PLANKS

- .1 38 mm thick (min.) chemically pressure treated (copper chromium arsenate) wood planks, extend 50 mm beyond conduit on each side.

2.4 WARNING TAPE

- .1 4 mil Polyethylene warning tape 75 mm in width. Text on tape to read "CAUTION BURIED ELECTRIC LINE BELOW".

2.5 MARKERS

- .1 Concrete type cable markers: as indicated, with words: "Cable", "Joint" or "Conduit" impressed in top surface, with arrows to indicate change in direction of duct runs.

PART 3 EXECUTION

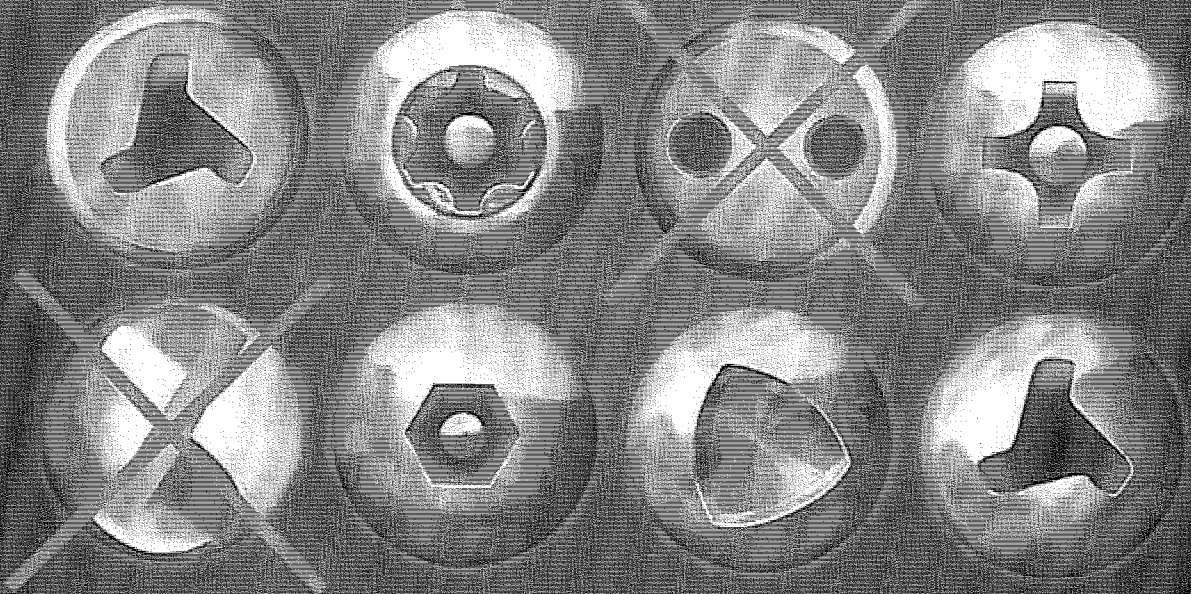
3.1 INSTALLATION

- .1 Install duct pipe in accordance with manufacturer's instructions.
- .2 Clean inside of ducts before laying.
- .3 Ensure full, even support every 1.5 m throughout duct length.
- .4 Slope ducts with 1 to 400 minimum slope.
- .5 During construction, cap both ends of ducts to prevent entrance of foreign materials.

- .6 Pull through each duct steel wooden mandrel not less than 300 mm long and of diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign material. Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .7 In each duct install a pull rope continuous throughout each duct run with 3 m spare rope at each end.
- .8 Install overlapping pressure treated wood planks over full length of ducts.
- .9 Install warning tape over length of underground ducts.
- .10 Install markers as required.

APPENDIX I - TAMPER PROOF SCREWS

Tamperproof screws are required where exposed in cells. Those with two holes, sometimes referred to as Snake Eyes, and those which cannot be reversed easily with the proper tool, as indicated below, are not allowed.



APPENDIX II - COMMISSIONING

APPENDIX B

COMMISSIONING PLAN

CIVIC BUILDING – INGONISH, NS

Issued for Tender

Prepared by: SNC Lavalin Inc.

Date: July 18, 2014

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Appendices:

- Appendix 1: Sample Training Plan
- Appendix 2: Sample Installation / Start Up Form
- Appendix 3: Sample Static Verification Form
- Appendix 4: Sample MMS input into working documents
- Appendix 5: Sample Functional Performance / Dynamic Verification Forms
- Appendix 6: Sample Commissioning Schedule
- Appendix 7: Sample Commissioning Binder Table of Contents
- Appendix 8: Sample Final Report
- Appendix 9: Detailed List of Building System Requiring Commissioning
- Appendix 10: Detailed Start-up Inspection and Functional Verification Forms.

CIVIC BUILDING– INGONISH, NS

THE PURPOSE OF THIS DOCUMENT IS TO:

1. INTRODUCE THE CONCEPT AND APPROACH TO THE COMMISSIONING OF THIS PROJECT.
2. DEFINE THE ROLE AND RESPONSIBILITIES FOR ALL THE PARTICIPANTS INVOLVED.
3. LIST AND DETAIL THE COMMISSIONING ACTIVITIES AND TEST;
AND
4. ESTABLISH A TENTATIVE SCHEDULE OF COMMISSIONING ACTIVITIES

1. INTRODUCTION

1. Commissioning is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Commissioning is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved.
2. Use this Commissioning Plan as master planning document for Commissioning. The Plan:
 1. outlines the organization, scheduling, allocation of resources, documentation, pertaining to implementation of Commissioning;
 2. communicates the responsibilities of team members involved in Commissioning Scheduling, documentation requirements, and verification procedures;
 3. sets out deliverables relating to O&M, process and administration of Commissioning;
 4. describes a process of verification of how built works meet design requirements;
 5. produces a completely functional system in accordance with the contract documents prior to issuance of Certificate of Occupancy;
 6. is a management tool that sets out scope, standards, roles and responsibilities, expectations, deliverables, and provides:
 1. overview of Commissioning;
 2. general description of elements that make up the Commissioning Plan; and
 3. process and methodology for successful Commissioning.

1.1 Commissioning Plan Objectives

1. To bring all building systems from the static completion to a state of dynamic operation;
2. Achieving, verifying and documenting the performance of the building systems to ensure that they meet the design documentation and the Departmental Representative performance requirements;
3. To confirm the installations meet the system performance requirement.
4. To ensure that the completed facility meets user and stated requirements.

2. COMMISSIONING TEAM ROLES AND RESPONSIBILITIES

2.1 The Commissioning Authority (CA)

1. Is an authorized representative designated by the Departmental Representative.
2. Leads and ensures that the Commissioning activities are carried out in accordance with the Commissioning Plan.
3. Reports to the Departmental Representative and ensures that the constructed systems perform in accordance with the performance and contractual requirements.
4. Co-ordinates the Design Consultant's involvement and solicits their co-operation in carrying out the Commissioning Plan to the extent that the consultant will provide a written

statement affirming that the building systems are operating in accordance with the performance requirements.

5. Is responsible for:
 1. Assembling the Commissioning Team at the first commissioning meeting and coordinating their activities in carrying out the Commissioning Plan.
 2. Chairing the commissioning meetings and distributing minutes.
 3. Participating in :
 1. The development of the Commissioning Plan Implementation Schedule; and hence, the co-ordination of this plan with the Contractor and the Contract Manager.
 2. The preparation of the supplementary Equipment Verification Forms.
 3. The preparation of the supplementary Performance Test Procedures.
 4. The provision of information to the PM on all Commissioning activities.
 5. The co-ordination of the operation and maintenance manual set up.
 4. Reviewing:
 1. Construction and manufacturers' mechanical / electrical / misc. shop drawings after the consultant's review.
 2. Commissioning procedures in the contract documents, prior to execution of tests.
 3. Operating/maintenance data prepared by the contractors, as indicated in the Contract Documents.
 4. Project schedules with Departmental Representative.
 5. Balancing reports.
 5. Witnessing/Verifying:
 1. Testing/balancing measurements and procedures. The Contractor shall submit, in writing, the air and water balancing procedures
 2. All tests specified in the contract documents. The CA shall initial all these documents at time of testing.
 6. Training:
 1. The CA in conjunction with the Departmental Representative shall co-ordinate the training Maintenance Provider.
 7. Seasonal Commissioning:
 1. The CA shall co-ordinate with the Contractor and Departmental Representative as to scheduling of the required personnel.
 8. Commissioning Reports
 9. The CA shall advise the Departmental Representative on coordination of activities during the plan execution.
 10. Issues the final commissioning certificate after successful completion of seasonal commissioning

2.2 Departmental Representative

1. Ensures that the commissioning activities are carried out in accordance with contract documents.
2. Works with the CA and the General Contractor to resolve technical difficulties which may arise during the process.
3. Ensures non-conformance issues are resolved with the CA in both design and execution.

4. Works with the Maintenance Provider to ensure that the appropriate personnel receive the specified training and are familiar with the system.
5. Ensures that all shop drawings, labour and materials necessary to implement commissioning, are supplied by the contractor.
6. Informs all parties of the test scheduling of mechanical and electrical installations, including site services.
7. Informs all parties of the project schedule with the co-operation of the Contractor and the CA
8. Attends the commissioning meetings.
9. Attends commissioning activities.

2.3 Design Team Consultants

1. Attends commissioning activities to certify that the systems meet the performance requirements.
2. Reviews all CA reports and issues any site instructions required.
3. Provides a complete and comprehensive description of system performance.
4. Co-operates with the CA by providing a written statement affirming that the building systems are operating in accordance with the performance specification.
5. Provides the Schematic Flow Diagrams required for commissioning and shall co-ordinate this activity with the CA.
6. Provides a complete Sequence of Operation for each system indicating all operating parameters, set points and schedules.
7. Provides a complete I/O Summary, which will be used as the main document in the Function and Final Performance Test.
8. Provides evaluations of each system's performance as per the design intent for inclusion in the Final Commissioning Report.
9. Provides a list of equipment to be commissioned along with the performance expected to be achieved for the project. The CA shall coordinate these requirements.
10. Forwards a copy of all shop drawings to the CA, through the Contract Manager, after review by the Contractor and Design Consultant.

2.4 Maintenance Provider

1. Participates in the commissioning process to receive an early introduction to the facilities systems and to provide operator feedback.
2. Identifies the prime areas of interest for the training of the building operators and maintenance staff.
3. The building operators and maintenance staff are invited to witness the start-up and testing activities and may provide comments, for future reference, on the operation and maintenance of the various systems, components and procedures.
4. The Maintenance Provider's representative is invited to attend the commissioning meetings.
5. Co-ordinates with the Contract Manager and CA ensuring that all appropriate staff receive the appropriate training.
6. Provides assistance during the seasonal (deferred) commissioning.

2.5 General Contractor

1. Co-operate fully with the CA in carrying out the Commissioning Plan. At the completion of Commissioning, they shall provide a written statement affirming that the building's systems are operating properly in accordance with the design intent of the specifications and construction drawings.
2. Ensure that all necessary labour and materials are supplied for the implementation of Commissioning.
3. The General Contractor shall appoint a Contractor's Commissioning Coordinator (CCC). The CCC shall provide coordination for the delivery and fulfilment of all roles and responsibilities of the General Contractor's scope as detailed in the Commissioning Plan.
4. Submit Supplementary Equipment Verification Forms and Performance Test Procedures to the CA for review and inclusion in the Cx Plan.
5. Prepare:
 1. A comprehensive commissioning schedule, co-ordinating the activities with the Sub Contractors, Contract Manager and CA.
 2. All testing procedures for all systems
 3. Schematics and flow diagrams necessary for Commissioning.
 4. The supply of all labour and materials required to perform seasonal commissioning as required by the CA.
 5. The Commissioning forms, as provided by the CA.
6. Prepare Commissioning Binder:
 1. The following documents shall be included in the Commissioning Binder.
 1. Commissioning Plan
 2. Commissioning Schedule
 3. Commissioning Meeting Minutes
 4. Warranties
 5. Architectural Systems Testing/Verification Reports

6. Mechanical Systems Testing/Verification Reports
7. Electrical Systems Testing/Verification Reports
8. Training and Orientation Documents
9. Seasonal
10. Final Balancing Reports
11. Commissioning Site Reports
12. Issues Log
13. Final Commissioning Plan and Report

3. COMMISSIONING PROCESS, ROLES AND RESPONSIBILITIES

1. The Commissioning Process and roles/responsibilities of all participants are as follows:

Commissioning Roles and Responsibilities Matrix						
LEGEND						
A=Accountable	P=Participates					
J=Joint Effort	N=Notify	Depart. REP	Maintenance Provider	Design Team Consultants	Cx Authority (CA)	General Contractor
S=Sign-off	V=Verify					Sub Trades
CONSTRUCTION STAGE						
	Depart. REP	Maintenance Provider	Design Team Consultants	Cx Authority (CA)	General Contractor	Sub Trades
Review Cx Plan	A	P	P	P	P	P
Review shop dwgs of equipment/systems being commissioned	P	P	S	P	A	
Update checklists for equipment/systems to be commissioned	N		N	A	P	P
Develop Cx Testing Procedures	N		N	P	A	P
Update and Maintain Cx Plan	N		P	A	P	P
Create Cx schedule	N			P	A	P
Review Cx schedule	A		P	P	P	P
Ongoing Cx meetings	P		N	A	P	P
Perform Static checks/testing	P		N	P/V	A	P
Identify Non-conformance Issues	P		N	A	P	P
Resolve Non-conformance Issues	N		N	V	A	P
Prepare and submit interim Cx Report	N		N	A	N	N
Perform Start up checks/testing	P		N	P/V	A	P
Identify Non-conformance Issues	P		N	A	P	P
Resolve Non-conformance Issues	N		N	V	A	P
Compile Static/Start Up Checklists as the work is performed	N			A	P	P
Perform Dynamic Testing of installed systems	P		N	P/V	A	P
Identify Non-conformance Issues	P		N	A	P	P
Resolve Non-conformance Issues	N		N	V	A	P
Compile Dynamic Checklists as work is performed	N		P	A	P	P
Update and submit Cx Report	N		N	A	N	N
Submit O&M Manuals for review and acceptance	S	P	P	P	A	P
Submit training schedule for review and acceptance	N	P		S	A	P
Coordinate User Training	A	P		P	P	P
Conduct User training	N	P		V	A	P
Submit & Review Cx Manual	S			A	P	P
POST CONSTRUCTION						
Initiate seasonal Cx	J		N	J	P	P
Perform seasonal Cx IAW specs	N	P	N	P/V	A	P
Identify Non-conformance Issues	P		N	A	P	P
Resolve Non-conformance Issues	N		N	V	A	P
Prepare and submit seasonal Cx Report	S	N	N	A	P	P

Commissioning Process

4. COMMISSIONING STATIC VERIFICATION FORMS

1. The Contractor shall be responsible for the completion of all static verification forms. Sample forms emphasizing the level of detail required are included in this document (Appendix 3). The Contractor shall sign the completed forms.
2. The CA shall witness the completed forms.

5. SHOP DRAWINGS

1. A copy of all Shop Drawings shall be forwarded to the Contract Manager, after review by the Contractor and Design Consultant.
2. The CA shall review the Shop Drawings, comment as necessary, and incorporate the data into the Commissioning Verification Process.
3. The CA shall inform the Departmental Representative, on all Non-Conformance issues using the Non-Conformance Report form.

6. SYSTEMS START-UP VERIFICATION

6.1 Coordination

1. The CA shall witness the systems tests as required by the tender documents and manufacturers' requirements. The Contractor shall provide an on-going updated Schedule for these tests and ensure that the appropriate personnel are present.
2. The Contractor shall provide a minimum written notice of two business / working days to the Contract Manager as to time and location of each test.

6.2 Forms

1. As a minimum, the Contractor shall use the sample Testing Forms included in the Commissioning Plan as well as any Supplementary Forms developed during the Commissioning Process.

6.3 Signatures

1. When the Tests have been successfully completed, the CA and/or the Contract Manager and the Contractor shall co-sign the Test Forms.

6.4 Non-conformance:

1. The CA shall report non-conformance results to the Departmental Representative.
2. Unsuccessful tests shall be repeated until they are successful at no additional cost to the contract.
3. The CA shall witness all repeated tests and assess the costs incurred by the Crown in hours, travel and other expenses. The Contractor shall be responsible for the costs.

6.5 Architectural Systems:

1. Start-up Procedures: Where applicable, witness and verify the start-up procedures for all architectural systems. Verify that the start-up procedure has been conducted according to the manufacturer's recommendations and as per the contract documents.

2. Contractor shall submit with the shop drawings, the manufacturer's Start-up and Inspection Forms for review by the Consultant and the CA. If appropriate, these forms will become part of the Commissioning Documentation.

6.6 Mechanical Systems:

1. Start-up Procedures: Witness and verify the start-up procedures for all mechanical systems. Verify that the start-up procedure has been conducted according to the equipment manufacturer's recommendations and as per the contract documents.
2. Contractor shall submit with the shop drawings, the manufacturer's Start-up and Inspection Forms for review by the Consultant and the CA. If appropriate, these forms will become part of the Commissioning Documentation.

6.6 Electrical Systems:

1. Start Up Procedures: Witness and verify the start-up procedures for all electrical systems. Verify that the start-up procedure has been conducted according to the equipment manufacturer's recommendations and as per the contract documents. This procedure must be co-ordinated with the mechanical start-up and performed at the same time. Documentation shall be recorded on the mechanical start-up forms.
2. Contractor shall submit with the shop drawings, the manufacturer's Start-up and Inspection Forms for review by the Consultant and the CA. If appropriate, these forms will become part of the Commissioning Documentation.
3. Provide ESA Certificate of Inspection.

6.7 Specialty Systems:

1. Start Up Procedures: Witness and verify the start-up procedures for all speciality systems as required. Verify that the start-up procedure has been conducted according to the equipment manufacturer's recommendations and as per the contract documents. This procedure must be co-ordinated with other systems start-up as required. Documentation shall be recorded on the start-up forms.
2. Contractor shall submit with the shop drawings, the manufacturer's Start-up and Inspection Forms for review by the Consultant and the CA. If appropriate, these forms will become part of the Commissioning Documentation.

7. SYSTEM DYNAMIC FUNCTIONAL PERFORMANCE TESTS

7.1 Objectives

1. The objectives are to verify:
 1. The performance of individual systems.
 2. That the performance of all systems operating together meets the building performance requirements.

7.2 Architectural Systems Dynamic Functional Performance Tests

1. Building Envelope and Interior Systems

1. The building envelope and interior systems tests will verify that the specified systems achieve the building performance requirements. Construction phase tests and procedures are to be developed in accordance with ASHRAE Guideline 0-2005 and NIBS Guideline 3-2006. Test verification procedures may include but are not limited to the following:
 1. air leakage;
 2. water leakage;
 3. thermal performance;
 4. fire resistance;
 5. acoustical performance;
 6. condensation control;

7.3 Mechanical Systems

1. Dynamic Functional Performance Testing shall begin when all the testing, adjusting and balancing required by the contract has been completed, and when the CA/Contract Manager has acknowledged that the physical installation of the components and systems being tested are substantially installed in accordance with the contract documents.
2. The CA may use the EMCS as well as any other instrumentation deemed necessary for mechanical systems testing. The EMCS shall be programmed to record print data over a specific time period. The CA/Consultant shall evaluate the performance of the systems by reviewing the EMCS recorded data and other recorded data.
3. Tests shall be conducted systematically for each system identified in the Commissioning Plan.

7.4 Mechanical Systems Dynamic Functional Performance Tests

1. Mechanical Equipment Start-up and Acceptance Forms (see Appendix 2 sample). Note the list below is an example only. The complete list will be provided when all the Shop Drawings and Product Data has been submitted: (include reference to annex, list of systems to be commissioned).
 1. Circulating pumps
 2. EMCS controls
 3. Unit heaters
 4. Hot water heaters
 5. Energy Recovery Ventilators
 6. Ventilation fans
 7. Air Handling Unit
 8. Split System Air Condition systems
 9. Fire suppression systems
 10. Plumbing fixtures and accessories
 11. Well Pump
2. Balancing:
 1. Demonstrate a minimum of 30% TAB readings or as per the performance specification whichever is more stringent. Record specified and measured readings on the TAB forms.

3. Energy Management Control System (EMCS):
 1. See appendices for sample test forms.
 2. Prove operation and calibration of EMCS by demonstrating all points for each of the control devices, including Digital points.
 3. Demonstrate all Reset Schedules and make any required adjustments to the schedules.
 4. Demonstrate specific hardware and software features under the direction of the CA or Consultant for Dynamic and Final Performance Tests.
 5. Sound/Vibration Tests
 1. If required the CA shall submit separate test reports for Sound and Vibration obtained from Specialist. Submit a document describing the procedures used in both cases. Submit a copy of the Standards of Acceptance for the equipment for this specific Project.

7.5 Electrical Systems Dynamic Functional Performance Tests

1. Electrical Tests (note the list below is an example only):
 1. Lighting Foot-Candle (initial) Readings. See appendices for sample test forms.
 2. Verification User Meter and Load Readings. See appendices for sample test forms.
 3. Fire Alarm Verification, to CFFM / ULC 537 latest version. Manufacturer to submit standard check and commissioning forms to the CA and Consultant for review, approval and integration into commissioning documents.
 4. Final Performance Test (before final acceptance test) to be witnessed by the electrical consultant and the CA.
 5. Loss and return of Utility Power. See supplied for sample test forms.
 6. Emergency Lighting Systems
 7. APU Power Systems
 8. Power Quality and grounding
 9. Lighting Control systems including scheduling, occupancy sensors, dimming controls, etc.
 10. Automatic Transfer Switches.
 11. Communication and Security Systems.

8. TRAINING

1. The Commissioning Authority and / or the Contract Manager shall coordinate the training that is provided by the Contractors and Equipment Manufacturers. This shall include:
 1. Co-ordinating and organizing all training specified.
 2. Selecting the Training Sessions to avoid conflict and allow the Building Operators and Maintenance staff sufficient time to read material before each session (Operation and Maintenance Manuals).
 3. Both Hands On and classroom training will be provided where required as deemed by the Commissioning Authority and / Maintenance Provider.
 4. The Commissioning Authority and / or the Contract Manager shall obtain from the Contractor and/ or Manufacturer the Training Materials required to accomplish such Training.
 5. Obtaining the Training Materials from each contractor/manufacturer prior to the training sessions and distributing to the Maintenance Provider via the Commissioning Authority and / or Contract Manager.

6. The Contractor is responsible to ensure instructors are well versed in the particular system that they are presenting.
 7. The CA is responsible for overseeing and approving the content and adequacy of the training. The CA must interview the facilities manager to determine the special needs and areas where training will be most valuable. The CA and Departmental Representative must decide how rigorous the training should be for each piece of equipment/system.
 8. If, at the end of a course, there are questions from trainees that remain unresolved, the instructor will send the answers, in writing, to the CA for transmittal to the trainees, and any training videos should be modified to include the appropriate clarifications.
 9. The CA shall develop criteria for determining that the training was satisfactory completed, including attending some of the training, and upon fulfillment of the criteria, validate training completion. The CA will recommend approval of the training to the Departmental Representative using a standard form and the Departmental Representative will sign the approval form. Provide completed and signed validation of training forms for all training sessions accomplished. Provide two copies of the signed training validation forms to the Departmental Representative.
2. The CA shall arrange for Training at the worksite if required.
 3. Each training session shall cover, as a minimum, the following:
 1. Demonstration of the equipment/system operation.
 2. Description of the equipment/system.
 3. Operating procedures.
 4. Maintenance by the Maintenance Provider.
 5. Maintenance provided by the manufacturer.
 6. Normal and special tools required for equipment servicing.
 7. Scope of the equipment warranty.
 8. A review of the Operations and Maintenance data.
 9. Start up and shut down procedures.
 10. Emergency procedures.
 11. Seasonal switch over.
 12. Training session shall be limited to a maximum of 4 hrs per day per group.
 4. Where equipment is part of the mechanical or electrical system, the training sessions shall identify how the equipment interacts with the system.
 5. EMCS and Fire Protection Manufacturer's training requirements are detailed in the contract documents. The Commissioning Authority and/or the Contract Manager shall coordinate the Training Sessions required.
 6. Additional Training (if applicable):
 1. Whenever the Maintenance Provider / Commissioning Authority and/or the Departmental Representative determines that there is a need to supplement Contractors and Manufacturer's Training, he shall request the Design Consultant's Participation.
 2. These Training Sessions shall be "Hands On" and in the classroom.
 3. The Training Concept shall be reviewed by the Departmental Representative the Maintenance Provider and/or the Commissioning Authority.

4. The sessions shall include:
 1. The Design Intent, Complete and up to date Sequence of Operations for each System. This will include a review of the O&M Manual (if applicable).
 2. The operation of the overall mechanical and electrical systems – include occupancy considerations, set points, seasonal change over, start up, shut down, and emergency modes.
 3. The daily operation of the EMCS by the vendor include:
 1. Maintenance Provider Sign on/off.
 2. Requesting and reviewing reports.
 3. Setting up historical logs
 4. Diagnostic procedures.
 5. Emergency procedures, management procedures.
 6. The daily operation of the fire alarm system and the interface with the Total Building Operation.
7. Training Records
 1. Prior to any training, the Contractor shall provide each instructor a Training and Orientation Record form. The instructor shall document each training session on the form (duration and general subjects covered).
 2. The instructor shall sign for the session and obtains the signature of each trainee. The instructor also checks off subjects covered on the Agenda. When the training is complete, the Contractor provides a copy of the Training and Orientation Record, and the instructor's Agenda to the Departmental Representative and CA. The Departmental Representative and CA review all documents and make final approval by signing it.
8. Training Plan
 1. See Appendix 1 – Sample Training Plan

9. FINAL ACCEPTANCE

1. Prior to the Interim acceptance, the Contractor shall have completed all tests including the System Function Performance Tests.
2. Prior to the Interim acceptance the CA shall assemble all completed testing forms, EMCS and Fire and Life Safety systems occupancy documentation and include them in the Commissioning Report.
3. If a Test on any equipment did not meet the Design Intent or Performance Test, the equipment will be re-tested prior to the system's acceptance, at no additional cost to the contract.
4. The consultants shall issue corrective measures if an acceptable performance is not achieved to the satisfaction of the Departmental Representative.
5. Acceptance by Departmental Representative shall not be given until all Test Results are satisfactory.
6. The Commissioning Authority and Design Consultant shall review and accept the results of the System Performance Tests and the CA will submit a Report on the findings to the Departmental Representative.

7. The Design Consultant will issue a certificate after the completion of seasonal Commissioning.

10. O&M MANUALS AND AS-BUILT DRAWINGS

1. The O&M Manuals are to be produced by the Contractors and are to be submitted in accordance with the contract documents before Substantial Completion. The As-Built drawings are to be maintained throughout the duration of the Project and submitted as soon as possible at time of completion. The As-Built documents will be reviewed by the appropriate Consultants. The Contract Manager is to review the As-Built Drawings on a monthly basis at the time of the Progress Claim review.
2. Refer to the Project Specifications for exact Instructions and Execution.

11. POST CONSTRUCTION – SEASONAL COMMISSIONING

1. The General Contactor should supply the schedule to return to undertake Seasonal Commissioning prior to substantial completion.
2. After all System commissioning has been accepted by the Contract Manager on behalf of the Project Manager, the Seasonal Commissioning shall be initiated.
3. The Commissioning Authority shall co-ordinate the Seasonal Commissioning with the Contract Manager and General Contractor. All trades and manufacturers that are required to perform these tests must be present.
4. The seasonal commissioning results shall be submitted by the Commissioning Authority.
5. Should the Commissioning Authority or Design Consultant identify operational problems during the Seasonal testing, corrective action shall be initiated.
6. Seasonal Commissioning documentation will include System Dynamic Functional Performance Tests in the form of Trend Logs in both text and graphical format.
7. The Test results are documented by the Commissioning Authority and are compiled in the Post-occupancy Report.
8. The Design Consultant issues a final Commissioning certificate.

Appendix 1 – Sample Training Plan

Appendix 1 – Sample Training Plan

1. General

- Training plan is to be developed as design progresses.
- Contractors commissioning schedule identifies:
 - i. how training is to be implemented;
 - ii. duration of each training session;
 - iii. instructors/trainers and participants; and
 - iv. other.

2. Development of Training Plan

- To be completed by _____ [e.g. within ___ months after award of Contract].

3. Responsibilities

- CA is responsible for training and will monitor all training activities
- CA will prepare agenda and outlines
- CA to arrange videotaping of sessions
- Contractor is responsible for implementation of training activities
- Contractor is responsible for quality of instruction, materials and instructor coordination

4. Instructors

- Instructors / trainers include:
 - i. Designers
 - ii. Contractors
 - iii. Factory-trained/certified equipment suppliers and manufacturers
 - iv. Factory-trained/certified maintenance specialist personnel
 - v. Service contractors holding service contracts for various systems

5. Trainees

- Trainees include:
 - i. Facility (Property) Manager
 - ii. Building operators
 - iii. Maintenance staff
 - iv. Security staff
 - v. Technical specialists
 - vi. Facility occupants as necessary

6. Prerequisite Skills and Qualifications of trainees

- [to be specified _____].

7. Scheduling of training

- Training sessions relating to design:
 - i. Provided by the Designer
 - ii. Presented within three months after contract award
 - iii. To be completed prior to issuance of the Interim Certificate

8. Details of training

- ...

9. Training materials

- Training materials may include:
 - i. "As-built" contract documents
 - ii. Building Management Manual
 - iii. TAB and PV Reports
 - iv. Transparencies for overhead projectors and 35 mm slides
 - v. Manufacturers' training videos (after prior screening for suitability)

- vi. Equipment models

10. Videotaping

- Hands-on and classroom sessions will be videotaped for future reference
- To be held only after all systems have been fully commissioned
- Production will be of professional quality

11. Standard of training

- Training will be sufficient to ensure:
 - i. safe, reliable, cost-effective, energy-efficient operation of all systems under all conditions;
 - ii. effective ongoing inspection, measurements of system performance;
 - iii. proper preventive maintenance diagnosis, troubleshooting;
 - iv. ability to update documentation; and
 - v. ability to operate equipment and systems under emergency conditions.

12. Limitations

- ...

13. Demonstrations

- Training will include demonstrations by trained personnel

14. Manufacturers' video-based training

- Video will be used as training tool after departmental representative's review and written approval

15. Sample Training Activities (broad outline)

- Architectural
 - i. Waste Management
 - ii. Building Envelope
- Mechanical
 - i. Design Philosophy
 - ii. HVAC Systems
 - iii. BAS, EMCS
 - iv. Refrigeration Systems
 - v. Fire Protection and Suppression Systems
 - vi. Dom. CWS Systems
 - vii. Storm Water Management Systems
- Electrical
 - i. General overview of design
 - ii. Incoming Service and High Voltage Distribution
 - iii. Low Voltage Systems (including low voltage lighting controls, clocks, fire alarm)
 - iv. Telephones, Communications, Signaling Systems
 - v. Security Systems
 - vi. Crash Alarm System
 - vii. Special Systems
 - viii. Lighting Systems
 - ix. Emergency Lighting Systems
 - x. Emergency Power Systems
 - xi. Uninterruptible power systems
 - xii. Isolated Power Systems
 - xiii. Special/Dedicated Electrical Services to Special Areas

Appendix 2 - Sample Installation / Start Up Forms

Appendix 2 - Sample Installation / Start Up Forms

SAMPLE AIR HANDLING SYSTEMS EQUIPMENT INSPECTION AND START-UP REPORT

PROJECT:

FILE NO:

GENERAL INFO:							
Manufacturer:				UNIT IDENTIFICATION:			
Model Number:				DWG. NO.			
Serial Number:				Location:			
Fan Type:				Type of Service:			
MOTOR DATA:							
Manufacturer:				Panel No.:			
Model:				Power (V/Ph/Hz):			
H.P.:				Thermal Protection:			
Type:				Fuse Rating:			
BURNER DATA:							
Manufacturer:				Model No:			
MOTOR DATA:							
Manufacturer:				Panel No:			
Model:				Power (V/Ph/Hz):			
H.P.:				Thermal Protection:			
Start-up Verification:	YES	NO	N/A				
Flexible Connections (Durodyne) Installed:				Unit Cleaned:			
Vibration Isolation Installed & Checked:				Power Wiring Complete:			
Piping & Ductwork Installation Complete:				Belt Drive Tension Adjusted:			

Alignment Complete:				Abnormal Vibrations:			
Filters Checked and/or Changed:				Direction of Rotation Correct:			
Lubrication Complete:				Air Mixing Dampers:			
REMARKS/COMMENTS:							
ACKNOWLEDGED				DATE			
Mechanical Contractor:				Date:			
General Contractor / Consultant:				Date:			
Commissioning Authority				Date:			

ANCILLARY DEVICES CHECKLIST - Are these items installed as per specification and drawings?

PROJECT:			FILE NO.:		
UNIT IDENTIFICATION:			DATE:		
DWG. NO.:					
ITEM			ACCEPTANCE		REMARKS
230713	Insulation	Supply			
		Return			
233113	Ductwork				
230516	Flexible Connections				
233300	Accessories	Access Doors			
		Test Ports			
233315	Operating Dampers - stroke open to closed				
233316	Fire and Smoke Dampers				
233720	Louvres, Intakes, Vents, Birdscreen				
230593	TAB (report submitted)				

- Acceptable
- Not Acceptable
- Not Applicable

REMARKS/COMMENTS:

ACKNOWLEDGED:

Date:

Mechanical Contractor:

Date:

General Contractor / Consultant:

Date:

Commissioning Authority:

Date:

Appendix 3 - Sample Static Verification Forms

Appendix 3 - Sample Static Verification Forms

SAMPLE STATIC CHECKLIST - AIR CONDITIONING UNIT

PROJECT:

FILE NO:

TAG ID: _____

1. Model Verification

	Submitted/Approved	Installed
Manufacturer		
Model		
Volts/Ph/A		
Min. OSAT		

2. Installation

The following items must be verified and initialed during installation. Circle "yes" or "no", or mark "N/A" if Not Applicable. For all negative responses, give details in Section 3.

			Initial/Date
2A	Submissions		
	Manufacturer's shop drawings received	Yes / No	
	Performance data received	Yes / No	
	Installation and startup manual and plan received	Yes / No	
2B	General Installation		Initial/Date
	Permanent labels affixed	Yes / No	
	Casing condition good: no dents, leaks, mounting correct	Yes / No	
	All coils are clean and fins are in good condition	Yes / No	
	Belt tensions are properly adjusted	Yes / No	
	Maintenance access acceptable for unit and components	Yes / No	
	Specified vibration and seismic control devices in place and isolation bolts loosened (Report attached if required)	Yes / No	
2C	Piping and Coils		Initial/Date
	Refrigerant piping in good condition, suction insulated	Yes / No	
	Liquid line solenoid valve located at evaporator coil	Yes / No	
	Compressor, liquid and suction line service valves open	Yes / No	
	Drip pans drain properly, traps primed	Yes / No	
2D	Site Charging		Initial/Date
	Refrigerant lines evacuated and dehydrated	Yes / No	

	Refrigerant charged by recommended procedures	Yes / No	
	Checked for leaks; using a leak detector, around the compressor, condenser, evaporator, TXVs, solenoid valves, filter driers and other piping fittings. (Confirmed leak-free)	Yes / No	
	Refrigerant sight glass clear of bubbles	Yes / No	
	Moisture indicator shows no moisture	Yes / No	
2E	Compressor and Condenser		Initial/Date
	Correct oil level during operation	Yes / No	
	Adequate clearance for airflow around condenser	Yes / No	
	Crankcase heater energized (if applicable)	Yes / No	
2F	Electrical and Controls		Initial/Date
	Power disconnects in place and labeled	Yes / No	
	All electric connections tight and correctly oriented	Yes / No	
	Proper grounding installed for components and unit	Yes / No	
	Circuit protection installed properly	Yes / No	
2G	Contractor General Test <i>(These augment mfr's list. This is not functional performance testing.)</i>		Initial/Date
	Condenser fan rotation confirmed to be correct	Yes / No	
	Equipment free of unusual noise or vibration during operation (condenser fan & compressor)	Yes / No	
	Adjust the space temperature controls to cause a call for cooling. Compressor starts and supply air is cooled	Yes / No	
	Remove the call for cooling. Compressor cycles off	Yes / No	
	Manufacturer's Startup Report completed and attached	Yes / No	
	Refrigerant usage report completed and attached	Yes / No	

3. Negative Responses (attach sheets as necessary)

Item	Reason for Negative response	Resolution

I certify that the data and test results as recorded herein are accurate.

Signature, Mechanical Contractor

Firm Name (Please Print)

Date

Area Code + Phone Number

SAMPLE STATIC CHECKLIST – DUCTWORK

PROJECT:

FILE NO:

SYSTEM TYPE: _____ **Grid Lines:** _____

1. Installation

The following items need to be verified during installation. Circle “yes” or “no”, or put “N/A” if Not Applicable. Initial all lines. For any negative responses, give details in Section 2.

1A	Ductwork	Contractor	Initial
	Ductwork complete and routed per design drawings	Yes / No	
	Ductwork installed level and square, no damage	Yes / No	
	Access doors provided where required, functional, tight	Yes / No	
	Balancing Dampers accessible and locked open	Yes / No	
	Joints sealed with sealant, tape and/or gaskets per spec	Yes / No	
	Supports of proper type and spacing as per spec	Yes / No	
	Support rods double-nutted and excess length trimmed	Yes / No	
	Ductwork internally insulated per spec, edges sealed	Yes / No	
	Ductwork externally insulated per spec, insulation free of damage from supports	Yes / No	
	Ductwork properly labeled	Yes / No	
	Ductwork leakage tested (report attached)	Yes / No	
	Ductwork properly cleaned (report attached)	Yes / No	
	Vibration/seismic restraints per spec (report attached)	Yes / No	
1B	Fire Dampers	Contractor	Initial
	Installed in locations noted in spec	Yes / No	
	Installation in accordance with NFPA 90A	Yes / No	
	Fusible link melting points recorded; per spec (____ °C)	Yes / No	
	Dampers operated freely, no binding (report attached)	Yes / No	
	Access doors provided and properly positioned	Yes / No	

2. Negative Responses (attach sheets as necessary)

Item	Reason for Negative response	Resolution

I certify that the data and test results as recorded herein are accurate.

Mechanical Contractor (Print name and sign)

Date

Firm Name

Area Code + Phone Number

SAMPLE STATIC CHECKLIST - SUPPLY FAN

PROJECT: _____

FILE NO: _____

TAG ID: _____

1. Model Verification

	Submitted / Approved	Installed

2. Installation Checks

The following items need to be verified during installation. Circle “yes” or “no”, or mark “N/A” for not applicable. Initial all lines. For any negative responses provide details in Section 3.

		Contractor	Initial/Date
2A	Physical Checks		
	General appearance good, no apparent damage	Yes / No	
	Shipping restraints removed	Yes / No	
	Seismic restraints installed per spec	Yes / No	
	Adequate maintenance access to all components	Yes / No	
	Access doors close tightly	Yes / No	
	Related air dampers move freely / close tightly	Yes / No	
	Equipment tags attached	Yes / No	
2B	Electrical	Contractor	Initial/Date
	Electrical connections tight	Yes / No	
	Power disconnects properly labeled	Yes / No	
	Motor contactors in good condition	Yes / No	
	Motor overload heaters properly sized	Yes / No	
2C	Fan:	Contractor	Initial/Date
	Fan belt tension & condition okay	Yes / No	
	Fan rotation correct	Yes / No	
	Fan blades clean	Yes / No	
2D	Contractor General Test:	Contractor	Initial/Date
	Run Test: Observe unit under normal operation & load. Verify that there is no unusual noise, vibration, or other problems	Yes / No	

4. Negative Responses (attach sheets as necessary)

Item	Reason for Negative response	Resolution

I certify that the data and test results as recorded herein are accurate.

Mechanical Contractor (Print name and sign)

Date

Firm Name

Area Code + Phone Number

Appendix 4 – Sample MMS input into working documents

Appendix 4 – Sample MMS input into working documents

VARIABLE VOLUME DUAL DUCT BOXES									
Tag ID	MMS Identifier	Size	Air Flow Rate		Reheat (Watts)	No. of Rows	Heating Coil		Notes
			Max	Min			(US GPM)	Elec (kW)	
VVDD-02-0									
VVDD-04-0									
VVDD-05-0									
VVDD-13-0									
VVDD-01-1									
VVDD-02-1									
VVDD-04-1									
VVDD-05-1									
VVDD-06-1									
VVDD-11-1									
etc.									

HUMIDIFIERS						
Tag ID	MMS Identifier	Air Flow Rate			Steam	
		Flow (L/s)	Temp (Celsius)	% RH	Flow (kg/h)	Press (kPa)
HUM-1	30-350-01	1,269	12.8	46 to 58	65	90
HUM-2	30-350-02	2,360	12.8	49 to 55	11	90
HUM-3	30-350-03	2,546	12.8	56 to 63	13	90
HUM-4	30-359-04	8,541	12.8	39 to 56	65	90

**Appendix 5 – Sample Functional Performance/Dynamic
Verification Forms**

Appendix 5 – Sample Functional Performance/Dynamic Verification Forms

SAMPLE HYDRONIC HEATING SYSTEM VERIFICATION FORM

Functional Performance Tests:			Date	Comments
.1	Activate pump start using control system command			
.2	Verify pressure drop across strainer			
.3	Verify strainers are clean			
.4	Verify pump inlet/outlet pressures			
	<u>Pump No.</u>	<u>Inlet Pressure</u>	<u>Outlet Pressure</u>	
	P-1			
	P-2			
	P-3			
	P-4			
	P-5			
	P-6			
	P-7			
	P-8			
.5	Operate pump at shut-off, 50% flow, and 100% flow. Plot test readings on pump curve. Verify specified flow is obtained. Attach copies of pump curve with plotted performance points to this form. See Balancing Report.			
.6	Verify motor amperage for each phase for each pump. Refer to form MV4 – 039 and Balancing Report.			
.7	Verify motor voltage phase-to-phase and phase-to-ground for each pump. Refer to form MV4 – 039 and Balancing Report.			
.8	Verify pumps operate without unusual vibration and noise. Refer to form MV4 – 039 and Balancing Report.			
Comments:				
Verified by:				
Commissioning Authority:		Date:		
Mechanical Contractor:		Date:		
General Contractor:		Date:		

Appendix 6 – Sample Commissioning Schedule

Appendix 6 – Sample Commissioning Schedule

No	Task	Duration	Start	Finish	Dates
333	Conduit installation				
334	Wiring installations				
335	Speakers installation				
336	Controls console installation				
337	Testing and commissioning				
340	Lightning protection installation				
341	testing				
	Emergency power installation				
351	Generator #1 installation				
352	Transfer switch installation				
353	Transfer switch testing				
354	Generator fuel installation				
355	Generator exhaust installation				
356	Ventilation system installation				
357	Ventilation system testing & Cx				
358	Integrated system testing & Cx				
	Lab Fume Hoods & BSC's				
411	LFH and BSC installation				
412	Exhaust ducting installation				
413	Controls				
414	Electrical installation				
415	Lab services installation				
416	Exhaust fan and ducting installation				
317	LFH & BSC testing and Cx				
418	Integrated testing with HVAC systems				

Appendix 7 – Sample Commissioning Binder Table of Contents

Appendix 7 – Sample Commissioning Binder Table of Contents

- 1.0 Scope
 - 1.1 General
 - 1.2 Specific Systems
 - 1.3 Building Systems Integration
 - 1.4 Terminology
- 2.0 Reference Publications
- 3.0 Definitions
- 4.0 Commissioning Process
 - 4.1 Commissioning Plan
 - 4.2 Commissioning Process
 - 4.3 Re-commissioning Process
 - 4.4 Responsibilities of the Commissioning Team
 - 4.5 Training and Education
 - 4.6 Documentation and Manuals
 - 4.7 Shop Drawings
- 5.0 Specific Systems
 - 5.1 Architectural
 - 5.1.1 Building Envelope
 - 5.1.2 Interior Space
 - 5.2 Mechanical
 - 5.2.1 Plumbing Systems
 - 5.2.2 Heating, Ventilation, and Air-Conditioning Systems
 - 5.2.3 Fire Protection Systems
 - 5.2.4 Refrigeration
 - 5.3 Control Systems
 - 5.4 Electrical Systems
 - 5.4.1 Incoming Electrical Service
 - 5.4.2 Electrical Main Distribution Systems
 - 5.4.3 Electrical Branch Distribution Systems
 - 5.5 Communication Systems
- 6.0 System Integration

Appendix 8 – Sample Final Report

Appendix 8 – Sample Final Report

MECHANICAL SYSTEMS FUNCTIONAL VERIFICATION

PROJECT:

FILE NO:

System 1.6 Fan Coils Supplemental Cooling (5)

Associated checklists: Supplemental CHW System, Electrical, EMCS Controls

1. Submittal / Approvals

Submittal. The above equipment and systems integral to them are complete and have been functionally tested. The Verification/Sequence of Operation has been tested and has been checked off only by parties having direct knowledge of the system, as marked below, respective to each responsible contractor. This Functional Verification is submitted as approved; subject to the attached list of Observations.

Approvals. This filled-out Verification Review has been carried out. The System is ready for full Operational Use with the Observations noted below.

Mechanical Contractor	Date		
Facility/Operations	Date	Mechanical Eng.	Date
Commissioning Authority	Date	Controls	Date

General Comments/Observations

OB1	Addition Fan Coil Units	The 5 Addition Fan Coil Units will be started up in the Fall of 2008 when the Areas are constructed and online.
OB2	Comm. Room Electrical Room and Elevator Room FC Power	All IT Room Fan Coils are on normal power: FC0-1/FC1-1/FC1-1 - 8NP101 FC2-1/FC2-2 – 7NX202 Action: All IT Room FC (Supplemental Cooling) should be on Emergency Power
OB3		
OB4		

2. Requested Documentation and Installation - Reviewed and Noted

Check Equip Tag->	System Services	Supp. CHW FC (5): 2FC0-1/1-1/1-2/2/1/2/2	Addition H/C FC (5): 2FC1-3/1-4/1-5/1-6/1-7
Manufacturer's shop drawings			
Manufacturer's Startup report			
Chilled Water/Heating Water Loop Installation Complete			
Fan Coil Ductwork Complete: Diffusers/Grilles			
Electrical Complete: Starter and Disconnect			
Filters Final installed			
Sequences and Control strategies			
TAB Report Submitted			
System and Equipment Training			
O&M manuals – As-builts Manual Supplied with Equipment			

➤ **Documentation complete as per contract documents for given trade** **YES** **NO**

3. Operational Verification

.1 Cooling Only Fan Coils: Communication Rooms (4) and Elev. Mach. Room

All Fan Coils in these areas are Supplemental Cooling only, constant volume, recirculation Fan Coil Units. The FC Fan will operate continuously to circulate air in the room and the 2 way cooling valve will be modulated by the Honeywell controller, based on local space temperature conditions, to maintain room space temperature at a set 21°C temperature.

The space sensor has a local temperature adjust to give the user the ability to locally adjust the space temperature.

Refer to attached System Graphics/Trends for more information.

Supp. Cooling Fan Coils (5)

Elev. Machine Room	Verified	Comments
Location – FC-1	Ceiling Hung	Basement North
Fan On/Off Operation	Verified	Fan Runs Continuously
Fan Status	Verified	Current Relay
Fan Alarm	Verified	Shut off Power to FC – Alarm @ OWS
Cooling Valve Operation	Verified	Normally open – 2 way valve Valve stem was repaired – March 2008
Room Temperature Sensor	20.4°C	20°C Setpoint
Room Cooling Load	Medium	Elevator Machine Room (3 Elev. Units). FC CCV @ 31%
Fan Coil Details	Verified	1.5 HP – 600vac - 1.56 FLA Running Amps – 1.1/1.1/1.1 amps OL Setting – 1.75 amps Air Flow Design – 1426 l/s CC Flow – 1.49 l/s

Level 1 Comm/Elect. Rooms	Verified	Comments
Location – 2FC1-1	Ceiling Hung	Level 1 Sector 8 North
Fan On/Off Operation	Verified	Fan Runs Continuously
Fan Status	Verified	Current Relay
Fan Alarm	Verified	Shut off Power to FC – Alarm @ OWS
Cooling Valve Operation	Verified	Normally open – 2 way valve
Room Temperature Sensor	21.2°C	21°C Setpoint
Setpoint Adjust	Verified	
Room Cooling Load	Low	FC CCV @ 23%
Fan Coil Details	Verified	3/4 HP – 600vac - 1 FLA Running Amps – 1/1/1 amps <i>OL Setting – 4.5 Amps ****</i> Air Flow Design – 565 l/s CC Flow – .47 l/s Note: The OL setting indicates 4.5amps however on a fractional HP motor the # of turns around the CT will reduce the indicated OL setting: ie 4.5 actually means approx. 1.5 amps

Level 1 Comm/Elect. Rooms	Verified	Comments
Location – FC1-2	Ceiling Hung	Level 1 South
Fan On/Off Operation	Verified	Fan Runs Continuously
Fan Status	Verified	Current Relay
Fan Alarm	Verified	Shut off Power to FC – Alarm @ OWS
Cooling Valve Operation	Verified – However appears to be leaking	Normally open – 2 way valve <i>Valve should be re-checked – appears to be leaking: SAT @ 18°C with valve @ 20% & 0%.</i>
Room Temperature Sensor	20.2°C	20°C Setpoint
Room Cooling Load	Low	FC CCV @ 24%
Fan Coil Details	Verified	3/4 HP – 600vac - 1 FLA Running Amps – 1.1/1.2/1.1 amps <i>OL Setting – 4.5 Amps ****</i> Air Flow Design – 565 l/s CC Flow – .47 l/s Note: The OL setting indicates 4.5amps however on a fractional HP motor the # of turns around the CT will reduce the indicated OL setting: ie 4.5 actually means approx. 1.5 amps

Level 2 Comm/Elect. Rooms	Verified	Comments
Location – FC2-1	Ceiling Hung	Level 2 North
Fan On/Off Operation	Verified	Fan Runs Continuously
Fan Status	Verified	Current Relay
Fan Alarm	Verified	Shut off Power to FC – Alarm @ OWS
Cooling Valve Operation	Verified Valve normally 100% open	Normally open – 2 way valve
Room Temperature Sensor	22.9°C	20°C Setpoint
Room Cooling Load	High	FC CCV @ 100%
Fan Coil Details	Verified	1/3 HP – 120vac – 10.2 FLA Running Amps – 10.1 amps OL Setting – 15 amp breaker (Panel 7NX202) Air Flow Design – 285 l/s

		CC Flow – .25 l/s
--	--	-------------------

Level 2 Comm/Elect. Rooms	Verified	Comments
Location – FC2-2	Ceiling Hung	Level 2 South
Fan On/Off Operation	Verified	Fan Runs Continuously
Fan Status	Verified	Current Relay
Fan Alarm	Verified	Shut off Power to FC – Alarm @ OWS
Cooling Valve Operation	Verified	Normally open – 2 way valve
Room Temperature Sensor	21.1°C	21°C Setpoint
Room Cooling Load	High	FC CCV @ 82%
Fan Coil Details	Verified	1/3 HP – 120vac – 10.2 FLA Running Amps – 9.5 amps OL Setting – 15 amp breaker (Panel 8NX202) Air Flow Design – 285 l/s CC Flow – .25 l/s

**Appendix 9 - Detailed List of Building Systems Requiring
Commissioning**

Appendix 9 - Detailed List of Building Systems Requiring Commissioning

Division 22 - Plumbing

- 22 10 10 Plumbing Pumps
- 22 11 18 Domestic Water Piping Copper
- 22 13 17 Drainage Waste and Vent Piping - Cast Iron and Copper

- 22 30 05 Domestic Water Heaters
- 22 42 00 Plumbing Fixtures
- 22 42 01 Plumbing Specialties and Accessories
- 22 42 03 Washroom Fixtures
- 22 42 20 Showers

Division 23 - Heating, Ventilating and Air-Conditioning (HVAC)

- 23 05 05 Installation of Pipework
- 23 05 19.01 Thermometers and Pressure Gauges - Piping Systems
- 23 05 29 Hangers and Supports For HVAC Piping and Equipment

- 23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment
- 23 05 93 Testing, Adjusting and Balancing For HVAC
- 23 07 13 Duct Insulation
- 23 07 15 Thermal Insulation For Piping
- 23 31 13.01 Metal Ducts - Low Pressure to 500 Pa
- 23 33 00 Air Duct Accessories
- 23 33 14 Dampers - Balancing
- 23 33 15 Dampers - Operating
- 23 33 16 Dampers - Fire and Smoke
- 23 33 46 Flexible Ducts
- 23 34 00 HVAC Fans
- 23 34 25 Packaged Roof Exhuasters
- 23 36 00 Air Terminal Units
- 23 37 13 Diffusers, Registers and Grilles
- 23 37 20 Louvres, Intakes and Vents
- 23 55 01 Electric Duct Heaters
- 23 72 00 Air-To-Air Energy Recovery Equipment
- 23 73 11 Air Handling Units – Packaged
- 23 81 24 Split Air Conditioning System
- 23 84 13 Humidifiers

Division 25 – Integrated Automation

- 25 00 00 EMCS – Energy Management Control Systems
- 25 90 01 Application and System Site Requirements – Sequences of Operation

Division 26 - Electrical

- 26 05 20 Wire and Box Connectors 0-1000 V
- 26 05 21 Wires and Cables (0-1000 V)
- 26 05 28 Grounding - Secondary
- 26 05 29 Hangers and Supports for Electrical Systems
- 26 05 31 Splitters, Junction, Pull Boxes and Cabinets

26 05 32 Outlet Boxes, Conduit Boxes and Fittings
26 05 34 Conduits, Conduit Fastenings and Conduit Fittings
26 09 23.01 Metering and Switchboard Instruments
26 09 43 Network Lighting Controls
26 12 16.01 Dry Type Transformers up to 600 V Primary
26 24 16.01 Panelboards Breaker Type
26 24 19 Motor Control Centres
26 27 26 Wiring Devices
26 27 28 Heaters - Electric
26 28 16.02 Moulded Case Circuit Breakers
26 28 23 Disconnect Switches - Non-Fused
26 29 01 Contactors
26 29 03 Control Devices
26 29 10 Motor Starters to 600 V
26 50 00 Lighting
26 52 00 Emergency Lighting
26 53 00 Exit Signs
26 56 19.02 Site Lighting

**Appendix 10 - Detailed Start-up Inspection and Functional
Verification Forms**

Appendix 10 - Detailed Start-up Inspection and Functional Verification Forms

Electrical Start-up Inspection Forms

Form	
<u>Number</u>	<u>Description</u>
EF4-007a	Equipment Inspection, Startup & Meggering Report Form
EF4-007b	Meggering Report Form
EF4-009	Equipment Inspection Report Form (Disconnects – Other than Equipment Isolating Switch)
EF4-016	Motor Control Center Equipment Inspection & Verifications Form
EF4-007	APU Power System Inspection Report
EF4-019	Wiring Devices Checklist Inspection Report Form
EF4-027a	Electrical Specialty Startup Report Form
EF4-028	Consolidated Load Balance Report Form
EF4-029	Certificates and/or Equipment Test Reports
EF4-030	Equipment Spare Parts Report
EF4-031	Generic Equipment Inspection & Startup Report
EF4-032	12 Step Final Electrical Acceptance Report
EF4-033	Electrical Site Visit Report Form

Electrical Functional Verification Forms

Form	
<u>Number</u>	<u>Description</u>
EV4-002	Power Distribution Verification Form
EV4-008	Motor Control Centre Verification Form
EV4-009	Power Cable and Terminations Verification Form
EV4-010	Conduits, Conduit Fastenings & Fittings Verification Form
EV4-013	Electrical Observation & Inspection Report
EV4-014	User Meter and Load Readings Electrical Systems Functional Performance Test Form
EV4-019	Electrical System Functional Performance Tests Form
EV4-021	Electrical Spare Parts Summary List
EV4-022	Lighting Foot-Candle Readings
EV4-023	Electrical Tests & Certificate Requirements Form

Mechanical Start-up Inspection Forms

Form

<u>Number</u>	<u>Description</u>
MF4-001	Mechanical Inspection Form
MF4-002	Mechanical Testing Report
MF4-008	Domestic Water Piping Inspection Form
MF4-009	Plumbing Specialties Inspection Report Form
MF4-011	Fire Protection Inspection Form
MF4-012	Thermal Piping Insulation Inspection Form
MF4-019	Cooling Coil Installation Inspection Form
MF4-022	Ductwork Inspection Form
MF4-023	Thermal Ducting Insulation Inspection Report Form
MF4-024	Factory Test Commercial Fans Inspection Form
MF4-027	Fire Damper Installation Prior To Concealment Form
MF4-028	Air Terminal Box Installation Inspection Form
MF4-029	Grill Register Acceptance Report Form
MF4-032	Mechanical Site Visit Report Form
MF4-033	EMCS Installation Inspection Form
MF4-034	EMCS Startup Verification Form
MF4-035	EMCS Functional & Final Commissioning Tests Form
MF4-036	EMCS Control Unit – Local Stand Alone Functional Test Form
MF4-038	Mechanical Equipment Spare Parts Report Form
MF4-040	Balancing Preliminary Procedures Report Form
MF4-046	Factory Applied Protective Coatings Inspection Form
MF4-055	Plumbing: Sanitary Drains, Roof Drains & Vents Inspection Form
MF4-056	Plumbing: Underground Services Verification Form
MF4-057	Controls & Instrumentation Form
MF4-058	Motor Starter and Control List Form
MF4-059	Sequence of Operations for Control Systems Form
MF4-060	I/O Points and Schematics Form
MF4-066	Wet Pipe Fire Suppression sprinklers Form
MF4-067	Domestic Hot Water Heater Form
MF4-069	Split AC Unit Form
MF4-070	Packaged DX Cooling Systems –form
MF4-072	Air Handling Unit Functional Performance Test

Mechanical Functional Verification Forms

Form

<u>Number</u>	<u>Description</u>
MV4-001	Piping Tests Verification Form
MV4-003	General Requirements – Mechanical Systems Verification Form
MV4-004	Fire Protection Verification Form
MV4-005	Plumbing Systems - Mechanical Systems Verification Form
MV4-012	Pumps Mechanical Systems Verification Form
MV4-013	Air Distribution Mechanical Systems Verification Form
MV4-015	Energy Management & Control System (EMCS) Verification Form
MV4-017	Duct Tests Verification Form
MV4-018	Deferred or Seasonal Commissioning Requirements
MV4-024	Sound & Vibration Levels
MV4-025	Air & Water Balancing Verification Form
MV4-028	Domestic Water System Verification of Operation Form
MV4-032	Seasonal Commissioning (Sample Spec)

MV4-033	Sound Level Systems Functional Performance Test Form
MV4-035	Dx Cooling Equipment Verification Form
MV4-036	Fan Coil Unit Verification Form
MV4-037	Unit Heaters Verification Form
MV4-038	Circulation Pump Verification Form
MV4-039	Water Pump Verification Form
MV4-041	Exhaust Fans Verification Form
MV4-043	Air Handling Unit Equipment Inspection & Startup Verification Form
MV4-044	Air Handling Unit Ancillary Devices Verification Form

MEGGERING REPORT FORM

PROJECT:
FILE NO:

EQUIPMENT REPORT

General Information:

Specification Reference:

Equipment Description:

DATE OF TEST	IDENTIFICATION	PHASE A	PHASE B	PHASE C	NEUTRAL

REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Electrical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

EQUIPMENT INSPECTION REPORT

PROJECT: _____

DATE: _____

FILE NO: _____

A. GENERAL INFORMATION:

**DISCONNECTS - OTHER THAN EQUIPMENT
ISOLATING SWITCH**

1. Spec. Ref: _____ Drawing Ref: _____
2. Location _____
3. Manufacturer _____
4. Enclosure Type _____

B. DISCONNECT DATA:

1. Voltage: _____ Amperage: _____
2. Fused: Unfused:
3. Feed from: _____

C. ACCEPTANCE INSPECTION:

1. Verify installation complete - accessible
2. Verify fuse size as indicated
3. Verify power available
4. Verify interior of switch cleaned
5. Verify exterior finish satisfactory/clean
6. Verify nameplate Identification

CHECKED	COMMENTS

REMARKS/COMMENTS: _____

Ensure all unused openings are closed with KO fillers.

ACKNOWLEDGED:

Electrical Contractor: _____

DATE: _____

General Contractor / Consultant: _____

DATE: _____

Departmental Representative: _____

DATE: _____

**MOTOR CONTROL CENTER
(EQUIPMENT INSPECTION AND VERIFICATION REPORT) Cont'd**

		CHECKED	
6.	Stop-Start push buttons, Selectro switches, Pilot lights		
	a) When provided, verify operation of push buttons, and switches. Inspect wiring to them; neatness.		
	b) Inspect wiring to pilot lights and lens are specified colour.		
7.	Master Terminal Section, when the unit wiring is specified Class 1, Type C		
	a) Confirm master terminals are identified and correspond with individual compartment identification		
	b) Inspect wiring, terminal connection and wire identification.		
8.	Control Relay(s) when specified, verify the following:		
	a) relay(s) identified		
	b) wiring identified		
	c) connections		
	d) coil voltage corresponds with control voltage		
	e) Fuse protection for control transformer (when transformer provided)		
	f) workmanship		
9.	Insulation resistance Testing (Meggering) by Contractor. Motors Should never be energized until meggered.		
	a) verify disconnect located at motor (when specified) is in the on position.		
	b) Megger each phase conductor from the load terminal of the starter to ground. Record reading on each conductor. (See forms)		
	NOTE: If motor(s) are provided with thermistor protection, NEVER Repeat, NEVER megger as this will destroy the termistor.		
	Contractor is responsible to provide instruments for testing and labour.		
10.	Motor Energized Equipment Operating		
	a) Verify the amperage draw of motor is within the limits of the overload protection.		
	b) When equipment has been adjusted to design requirements, (air balanced, flow, etc.) record amperage on feeder conductor. Verify within limits.		
11.	After system is operating the fire alarm shutdown and evacuation (when specified) sequence is to be verified in accordance with contract documents.		
	Note: When this test is performed, the starting and stopping of motors should be reduced as much as possible.		

**MOTOR CONTROL CENTER
(EQUIPMENT INSPECTION AND VERIFICATION REPORT) Cont'd**

B.	GENERAL INFORMATION: MOTOR CONTROL CENTER		
	Equipment Designation:	Feed From:	
	Location:	Specification Reference:	
	Model No.:	Drawing Reference:	
	Manufacturer:		

C.	Acceptance Inspection	DATE CHECKED	COMMENTS
	1) VERIFY UNIT INSTALLATION COMPLETE:		
	2) VERIFY GROUNDINGS OF CONDUITS:		
	3) VERIFY EACH UNIT IS CLEAN:		
	4) VERIFY INSTALLATION OF INSTRUMENTS COMPLETE:		
	5) VERIFY INSTALLATION OF CONTROLS COMPLETE:		
	6) VERIFY THE OPERATION OF EACH UNIT – VERIFY BREAKER AND STARTER IS SATISFACTORY:		
	7) VERIFY OVERLOADS ARE COMPATIBLE WITH MOTORE NAMEPLATE AMPERAGE:		
	8) VERIFY EXTERIOR IS CLEAN AND PAINT FINISH IS ACCEPTABLE:		
	9) VERIFY WIRING DIAGRAM IN EACH UNIT:		
	10) VERIFY CONTROL TRANSFORMER FUSE IS NOT BY-PASSED:		
	11) VERIFY IDENTIFICATION – EACH UNIT:		
	12) VERIFY MEGGERING OF EQUIPMENT:		
	13) VERIFY BUSS AND FEEDER CONNECTIONS ARE TORQUED AS PER MANUFACTURER’S RECOMMENDATIONS:		

C.	Operational Check	DATE OF READINGS:
	VOLTAGE: PHASE	A-B
		B-C
		C-A
	CURRENT PHASE	A
		B
		C

REMARKS/COMMENTS:	
ACKNOWLEDGED:	DATE
Electrical Contractor:	Date:
General Contractor / Consultant:	Date:

**MOTOR CONTROL CENTER
(EQUIPMENT INSPECTION AND VERIFICATION REPORT) Cont'd**

Departmental Representative:	Date:

CONSOLIDATED LOAD BALANCE REPORT FORM

PROJECT: Dining Facility, CRPTC
FILE NO: HQ 032 22

EQUIPMENT REPORT

General Information:

Specification Reference:

Equipment Description:

DATE OF READING	IDENTIFICATION	PHASE A	PHASE B	PHASE C	NEUTRAL

REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Electrical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

ELECTRICAL EQUIPMENT SPARE PARTS REPORT

PROJECT:
FILE NO:

A.	GENERAL INFORMATION:
	(1) EQUIPMENT DESCRIPTION:
	(2) SPECIFICATION REFERENCE:
	(3) PARTS:
	(4) NAME OR ORIGINAL MANUFACTURER:
	(5) MANUFACTURER'S PART/REFERENCE NUMBER:
	(6) HOW PACKAGED AND IDENTIFIED:
	(7) SEQUENTIAL LIST OF ACTIVITIES REQUIRED TO PERFORM REPLACEMENT TASKS:
	(8) ESTIMATE OF TIME FREQUENCY FOR PART REPLACEMENT IN MAN DAYS:
ADDITIONAL REMARKS/COMMENTS:	
ACKNOWLEDGED:	DATE
Electrical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

(GENERIC) EQUIPMENT INSPECTION & STARTUP REPORT

PROJECT:	
FILE NO:	

A.	GENERAL INFORMATION:		
	Equipment Description:	Specification Reference:	
	Equipment Designation:	Drawing Reference:	
	Location:	Serial No.:	
	Manufacturer:	Model No.:	
B.	MOTOR DATA		
	Motor Designation:	Type:	
	Starter Designation:	Power:	
	Feed From:	H.P.:	
	Manufacturer:		
C.	ACCEPTANCE INSPECTION:	DATE CHECKED	COMMENTS
	(1) Verify unit installation complete		
	(2) Vibration isolation when specified		
	(3) Electrical/Mechanical connections complete		
	(4) Installation of instruments complete		
	(5) Installation of Controls complete		
	(6) Lubrication is complete when applicable		
	(7) Electrical power wiring - complete		
	(8) Starter - clean		
	(9) Overload heater, size acceptable		
	(10) Breaker/Fuse rating: as indicated		
	(11) Safety device(s), operational		
	(12) Power available:		
	(13) Removal of temporary items		
	(14) Verify unit is clean		

(GENERIC) EQUIPMENT INSPECTION & STARTUP REPORT cont'd

D.	OPERATIONAL CHECK		
	VOLTAGE - on NAMEPLATE _____	CURRENT - on NAMEPLATE _____	
	A-B:	A-N:	A:
	B-C:	B-N:	B:
	C-A:	C-N:	C:
			N:
		DATE CHECKED	COMMENTS
	(1) Check abnormal vibrations		
	(2) Check direction of rotation		
	(3) Check local safety devices		
	(4) Check local controls		
REMARKS/COMMENTS:			
ACKNOWLEDGED:		DATE	
Electrical Contractor:		Date:	
General Contractor / Consultant:		Date:	
Departmental Representative:		Date:	

12 STEP FINAL ELECTRICAL ACCEPTANCE REPORT

PROJECT:	COMPLETION	COMMENTS
FILE NO:	DATE	

A.			
1.	All equipment has been cleaned both interior and exterior, with paint--touched-up as required.		
2.	Panel trim covers, disconnect switches, MCC's, switches, receptacles, etc. are free of paint or paint spatters with the covers installed TRUE vertical.		
3.	Lighting fixtures are clean, lens free of dust and 100% operational.		
4.	Electrical rooms, telephone rooms, telephone cabinets, etc., are cleaned and free of dust and NOT USED FOR STORAGE AREAS.		
5.	Exterior floodlighting has been adjusted (when applicable) to provide adequate coverage of the area.		
6.	All motors have been checked and verified; they are operating in normal temperature range under load.		
7.	Panel circuit directories are typewritten and indicating the location/load of each circuit. Lock-on devices installed as indicated. Keys have been provided the departmental representative.		
8.	Exposed non-galvanized hangers, racks and fastenings are painted to prevent rusting.		
9.	Sleeves, firewalls and floor penetrations have been sealed in accordance with Section 16010.		
10.	Nameplate identification provided on all equipment as indicated in Section 16010.		
11.	Access space to all equipment verified to provide easy access for maintenance on the equipment in accordance with electrical safety code.		
12.	Departmental representative's maintenance personnel have received the specified training and are familiarized with all aspects of the project.		

ADDITIONAL REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Electrical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

POWER DISTRIBUTION VERIFICATION FORM

PROJECT: FILE NO:	DATE CHECKED	COMMENTS
A. Confirm that equipment quantities and locations match the drawings and specifications.		
B. Check rating as of equipment with the drawings and specifications.		
C. Check installation of equipment for code clearances and fastening.		
D. Witness all Division 16 testing of equipment as specified in each section if applicable.		
E. Perform Functional check of all breakers:		
1) Verify sizes and ratings.		
2) Verify field-testing of breaker trip ratings.		
3) Confirm provision for spare breakers.		
4) Protective device coordination study completed and approved.		
F. Confirm that all bus and cable connections are torqued as per manufacturers recommendations prior to energizing.		
1) Verify infrared thermography following energizing.		
G. Confirm all protective device ratings and trips.		
H. Verify the manufacturer's testing of equipment including digital metering system at main switchboard and obtain their certificates.		
I. Verify Identification at:		
1) Panels		
2) Breakers		
3) Switches		
4) Conductors		
5) Raceways		
6) Splitters		
7) Junction boxes		
8) Equipment etc.		
J. Verify grounding of all equipment as to Specification and code.		
1) Confirm provision of ground test reports.		
K. Verify load balance on all dry core transformers.		
1) Panelboards.		
2) Main switchboards.		
3) Verify secondary voltages.		

POWER DISTRIBUTION VERIFICATION FORM cont'd		DATE CHECKED	COMMENTS
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L.	Verify voltage drops throughout the building do not exceed Code requirements.		
M.	Verify that operating tools are present.		
N.	Verify that panel backboards are mounted on plywood and gyprock as to specification and code.		
P.	Verify clearances as to code and accessibility.		
Q.	Confirm that access doors are installed where shown or required as to specification, drawings and code.		
R.	Confirm that all panelboards, cabinets, splitters, switchboards have been appropriately cleaned.		
S.	Keys.		

REMARKS/COMMENTS:

ACKNOWLEDGED:

Electrical Contractor:

General Contractor / Consultant:

Departmental Representative:

DATE

Date:

Date:

Date:

MOTOR CONTROL CENTRE VERIFICATION FORM

PROJECT: FILE NO:	DATE CHECKED	COMMENTS
A.	Verify the shop drawings comply with the contract documents.	
B.	Review design brief to assure motor control and starter schedule has been supplied if requested in the document.	
C.	3. Verify the following: <ul style="list-style-type: none"> 1) Starter locations as per contract documents. 2) Ratings. 3) Characteristics comply with motor control and starter schedule 4) Voltages and coils and contacts accommodate the EMCS system. 	
D.	Verify the starters and controls are installed as per manufacturer's recommendations.	
E.	Verify that spare parts (fuses, lamps etc) have been supplied as to contract documents.	
F.	Verify that wiring diagrams have been inserted in the Motor Control Centre(s) and terminal identification and wiring identification are as specified and to code.	
G.	Verify motor control centre bus, cable and lugs are properly torqued as per manufacturer's recommendations.	
H.	Verify all tests indicated in Div. 16 documents in relationship to the Motor Control Centre(s).	
I.	Verify motor overloads match the motor characteristics. See Mechanical Static Forms, this work to be performed the same time as mechanical equipment start-up, coordinate and schedule.	
J.	Verify all motor control functioning and interlocks are operating properly. Co-ordinate with Division 15 of the specifications.	
K.	Verify operation of all disconnect switches and verify all pilot lights are installed and working as to contract documents.	
L.	Verify that all Motor Control Centres and starters have been thoroughly cleaned and free of dust.	
M.	Verify all starters and mcc are identified as per spec.'s (lamacoids).	
	Note: Attach Non-Conformance Report (ADMIN 4-34) to this document, including report re: Consultants design brief.	

MOTOR CONTROL CENTRE VERIFICATION FORM cont'd	DATE CHECKED	COMMENTS
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REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Electrical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

POWER CABLE AND TERMINATIONS VERIFICATION FORM

PROJECT:	DATE	COMMENTS
FILE NO:	CHECKED	

	Specification Section:		
A.	Ratings		
B.	Installation as Per Contract Documents		
C.	Continuity		
D.	D.C. Test		
E.	Ground Resistance Test		
F.	High-Pot Test		
G.	Terminations Verified		
H.	Design Consultant Notified Prior To Tests		
I.	Verify Manufacturer's Pulling Plan submitted for his voltage - shielded cable. To include max. pull tension, max. bending radius, and max. side wall pressures.		
	Note: <i>Attach Non- Conformance Report to this Form</i>		

REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Electrical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

ELECTRICAL SYSTEMS FUNCTIONAL PERFORMANCE TEST FORM

PROJECT:	
FILE NO:	

ELECTRICAL SPEC. SECTION:	RELATED ELECTRICAL DRAWINGS:
---------------------------	------------------------------

VERIFICATION USER METER AND LOAD READINGS

USER METERING DATA

MFG:	CT /5A (X)
MODEL:	PT -120V (X)
STYLE:	SERIAL NO.:

	VERIFICATION			READINGS @ BOD *	
	USER METER	TRUE RMS MULTIMETER	COMMERCIAL METER	USER METER	COMMERCIAL METER
IA AMPS					
IB AMPS					
IC AMPS					
IN AMPS					
IA MAXIMUM					
IA MAXIMUM				(1)	
IB MAXIMUM				(1)	
IC MAXIMUM				(1)	
VAB VOLTS					
VBC VOLTS					
VCA VOLTS					
VAN VOLTS					
VBN VOLTS					
VCN VOLTS					
VNG VOLTS					
KVA					
KW					
KW MAX.				(1)	
MWH				(2)	(2)
KVAR					
KVAR MAX.				(1)	
MVARH					
PF					

NOTE: (1) = RESET AFTER READING (2) = TO BLDG. RECORDS, INCLUDE DATE / HOUR
 (*) = BENEFICIAL OCCUPANCY DAY

ELECTRICAL SYSTEMS FUNCTIONAL PERFORMANCE TEST FORM cont'd

REMARKS/COMMENTS:

ACKNOWLEDGED BY:	DATE
Electrical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

**ELECTRICAL SYSTEM FUNCTIONAL PERFORMANCE
TEST FORMS**

PROJECT: FILE NO:	DATE CHECKED	COMMENTS
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1.	Tests to be completed prior to Interim Acceptance of the building:		
	(i) Lighting LUX (Initial) Readings – (EV4-016)		
	(ii) Verification User Meter & Load Readings – (EV4-014)		
	(iii) Fire Alarm Final Verification – (EV4-015)		
	(iv) Loss and return of Utility Power – (EV4-020)		
	(v) Non-Conformance Report – (EV4-026)		
	(vi) Motor Control Centre Verification - (EV4-008)		
	(vii) Overcurrent Relays		
2.	Tests to be completed at the Final Acceptance of the building:		
	(i) Lighting LUX (Initial) Readings - (EV4-016)		
	(ii) Verification User Meter and Load Readings -(EV4-014)		
	(iii) Fire Alarm Final Verification - (EV4-015)		
	(iv) Loss and return of Utility Power - (EV4-020)		
	(v) Non-Conformance Report - (EV4-026)		
	(vi) Motor Control Centre Verification- (EV4-008)		
	(vii) Overcurrent Relays		

REMARKS/COMMENTS:

Note: We request the General Contractor inform sub-contractors and return signed copy to Departmental Representative.

ACKNOWLEDGED:	DATE:
Electrical Contractor:	Date:
General Contractor / Consultant	Date:
Departmental Representative:	Date:

ELECTRICAL TESTS AND CERTIFICATE REQUIREMENTS

Project Name:

Date:

Project No.

<u>Specification Section</u>	<u>Test Description</u>	<u>Date Performed</u>	<u>Date Received</u>

Departmental Representative:	Date:
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MECHANICAL INSPECTION FORM

PROJECT: FILE NO:	DATE CHECKED	COMMENTS
1. Equipment Installation:		
a. Verify coils or tube bundles can be removed ; verify that access doors open fully and that there is a means for quick disassembly i.e., unions, flanges and breakaway joints.		
b. Verify size and locations of housekeeping pads.		
2. Protection of Openings During Construction		
a. Open ends of piping and/or ducts to be capped or plugged.		
b. Verify equipment is protected, i.e., cribbed up and tarped; should not be left outdoors with no protection.		
3. Equipment Supports		
a. Verify as to size and location of supports are as per Contract Documents.		
4. Sleeves		
a. Verify schedule of sleeves.		
b. Verify where sleeves are extended above finish floor as per Contract Documents		
c. Verify sleeves are flush with floor as to the requirements of Contract Documents.		
d. Verify installation of sleeve in all types of walls are as per Contract Documents.		
e. Verify proper clearance in sleeve as per Contract Documents.		
5. Tests		
a. Contractor to use new pressure gauges with a valving arrangement to isolate system under test.		
b. Prior to test, walk or check system and verify the piping to be tested: full system or partial. After hydraulic pressure test, open a cap or an end of run valve to verify system is full. On drainage, waste/vent make sure you have a 10-foot head minimum. If water level drops, check joints for leaks.		
c. Prior to test, verify all equipment no designed to withstand test pressure is isolated.		
d. Record all tests on test forms, sign with witness .		
e. As tests last 4 hours, or specified time, mark gauge at time of test. There may be a slight increase and/or decrease depending on ambient temperature.		
6. Painting		
a. Verify number of coats of corrosion primer paint to ferrous supports and site fabricated work.		
7. Access Doors		
a. Verify size of Access Door that is required.		
b. Verify with Contractor that the door opens and closes fully.		
c. Verify the concealed device is serviceable through this door .		

		DATE CHECKED	COMMENTS
8.	Drain Valves		
	a. Verify locations of system low points to allow for system, piping or equipment drainage.		
	b. Install on all down fed radiation, at the bottom of risers and lowest radiation elements.		
9.	Cleaning		
	a. Verify the following:		
	– cleaning of strainers;		
	– vacuuming of interior of air handling units;		
	– cleaning of interior of the ductwork;		
	– blocking of open ends of ductwork.		
10.	As-builts		
	a. See specification for requirement.		
11.	Tab		
	a. Refer to Contract Documents for requirements.		
	b. Verify proof of calibration for each instrument prior to commencing balancing. All instruments must be calibrated within 6 months of TAB start, and listed with serial number when calibrated, and by what agency. Refer to Specification.		
12.	Pipe Hangers and Supports		
	a. Where structural bearing does not exist it is expected to have the Contractor provide supplementary support of either channel or angle sized for load, properly cut, fastened and primed.		
	b. Verify that when trapezing from steel joists, steel washer plates with double nuts are used.		
	c. Verify rod is the material specified.		
	d. Verify hot and cold piping insulation, 32 mm (1 1/4) and over, not interrupted and is continuous under both shield and/or saddle.		
	e. Verify shields are fabricated and installed per Grinnell, fig. 167. Verify the shield on the outside of the thermal insulation has enough length so that when hanger is taken up the shield does not crush the insulation.		
	f. Verify Saddles are equal to Grinnell, fig. 160 to 166 and insulation must be cut wedge style and placed full length in saddle feet.		
	g. Verify rod diameter and hanger spacing as per specification.		
	h. Verify the installation of hanger within 300mm (12") of each horizontal elbow in all piping systems.		
13.	Thermometers and Pressure Gauges		
	a. Verify the location of all thermometers and gauges.		
	b. Verify the operating is at mid-range point for each system. Refer to Specification.		
	c. Verify the installation of snubbers on gauges as per Contract Documents		
15.	Identification		
	a. Review submitted samples prior to engraving.		

		DATE CHECKED	COMMENTS
	b. Verify mock-up on all devices (piping, duct work, etc.). Surfaces should be properly prepared making sure there is proper adhesion. Apply clear tape at each end of marker, wrapping it horizontally around marker at each end.		
	c. Verify identification is installed as per Contract Documents.		
	d. Verify that the Contractor has tagged valve stems not handles		
16.	Vibration Isolation		
	a. Verify all mounts and springs, assure they have not collapsed or bottomed out.		
17.	Thermal Insulation For Piping		
	a. Verify the sample board meets Contract Document Requirements.		
	b. Verify that covering is not installed until required tests for that system are completed.		
	c. Verify thermal insulation is continuous over full length of pipe without interruptions at sleeves, supports and/or hangers.		
	d. Verify workmanship in concealed areas plus at all fittings.		
18.	Thermal Insulation For Ducting		
	a. Check systems, and those found with bulges or damage in the duct insulation, to be repaired.		
19.	Thermal Insulation For Equipment		
	a. Verify the sample board meets Contract Document Requirements.		
20.	Domestic Water Supply		
	a. NOTE: It is against the Canadian Plumbing Code to chemically disinfect a potable water system.		
21.	Cleanouts		
	a. Verify cleanouts required by code at base of all stacks and rainwater leaders. Refer to specification for requirements.		
	b. Cleanouts must be brought up to finish floor level or to inside face of walls to be serviceable. Refer to Specification.		
	c. Verify access covers at all cleanouts. Refer to Specification (execution).		
22.	Waterhammer Arrestors		
	a. Verify arrestors on both hot and cold supplies to each fixture and/or group of fixtures complete with isolating valve (refer to Contract Documents).		
23.	Back Flow Preventors		
	a. Verify installation as per Contract Documents as to type and location. If not shown, verify with designer.		
24.	Trap Seal Primers		
	Normally tied-in to a plumbing fixture on the cold side so the primer is only activated when fixture branch is open.		
	a. a trap primer for each trap complete with necessary valving, piping and access door, or urinal tanks to serve mechanical rooms with a graded piping system including all accessories.		
	b. Verify accessibility.		
	c. Verify operation by removing top of floor drain, activating fixture, then		

		DATE CHECKED	COMMENTS
	observe down floor drain stub to see if primer water is flowing.		
25.	Plumbing Fixtures and Trim		
	Normally tied-in to a plumbing fixture on the cod side so the primer is only activated when fixture branch is open.		
	a. A trap primer for each trap complete with necessary valving, piping and access door, or urinal tanks to serve mechanical rooms with a graded piping system including all accessories.		
	b. Verify rough-in trim on mop sink and shower supply valve/head. Assure trim is fastened properly.		
	c. Verify fixtures are fastened properly.		
26.	Steel Piping		
	a. Verify grades in appropriate direction.		
	b. Verify take-off from top of main on a 45° angle for Up Feed and 45° angle from bottom on Down Feed.		
	c. Verify saddling requirements as per Contract Documents.		
	d. Whenever there is a pipe size change, this change is to be made using eccentric reducers. Steam reduction on top of main, hot water on bottom of main (refer to Specification).		
27.	Heating/Cooling Pumps		
	a. Verify that bearing lubrication points are accessible.		
	b. Verify gland drip drain piped to nearest floor drain, if specified.		
	c. Verify the installation of pet cock volute to allow for venting. Verify accessibility.		
28.	Convectors		
	Refer to Specification with reference to the requirement of a Mock-up.		
	a. Verify access doors at valves, vents, and rains. Verify hand access for servicing.		
	b. Verify installation of filler pieces.		
	c. Verify installation of finned tubes, comb as required.		
29.	Low Pressure Duct		
	a. Flexible Connections – Verify type and installation requirements as per Contract Documents.		
	b. Verify hangers or rods do not break continuity of insulation vapour barrier.		
	c. Verify watertight duct as specified, on:		
	▪ Outdoor intakes – fresh air.		
	▪ Minimum 3000 mm from duct mounted humidifier in all directions.		
	▪ As indicated on drawings, form bottom of horizontal duct without seams, solder or weld joints of bottom and side sheets, seal all other joints with duct sealer.		
30.	Duct Accessories		
	a. Flexible Connections – verify type and installation requirements as per Contract Documents.		

		DATE CHECKED	COMMENTS
	b. Verify installation of access doors as per Specification and Code requirements.		
	c. Test Ports – verify installation. Refer to Contract Documents for type and location.		
31.	Damper Balancing		
	a. Install where shown and as requested by balancing contractor.		
32.	Acoustic Duct Lining		
	a. Verify the installation as to Contract Documents.		
	b. Verify type of liner (rigid or flexible).		
	c. Verify installation of pins, adhesive, leading and trailing edges, etc. Refer to Contract Documents.		
33.	Commercial Fans		
	a. Verify fans are protected from the weather if on site prior to required date.		
	b. Verify condition of fans upon arrival on site.		
	c. Verify inlet vane operation, if applicable.		
	d. Verify with the TAB documents the requirements for final air balance required.		
34.	Built-up Air Handling Units		
	a. Verify field assembly.		
	b. Fresh air intake plenum watertight complete drain pan and drain. Refer to Contract Documents.		
	c. Verify unit with submitted and reviewed Shop Drawings.		
	d. Verify blade dampers at grilles and volume control dampers at diffusers.		
	e. Verify workmanship.		
	f. Verify all specified components are as per Contract Documents and with reviewed Shop Drawings.		
36.	Grilles, Registers and Diffusers		
	a. Verify sizes and capacities.		
	b. Verify full perimeter gaskets.		

	DATE CHECKED	COMMENTS
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REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

						DATE CHECKED	COMMENTS
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WORKING PRESSURE		DIAMETER OF			LENGTH OF PIPE Or TUBING		TEST PRESSURE		TEST DURATION
psig	(kPa)	NPS	inches	(mm)	feet	(m)	psig	(kPa)	hours
0-2	(0-14)	Up to ½	¼ -5/8	(6-15)	100 or less	(30)	25	(175)	0.5
0-2	(0-14)	Up to ½	¼ -5/8	(6-15)	> 100	(30)	50	(350)	1.5
0-2	(0-14)	Over ½	Over 5/8	(15)	100 or less	(30)	25	(175)	1.0
0-2	(0-14)	Over ½	Over 5/8	(15)	> 100	(30)	50	(350)	2.0
2-33	(14-230)	All Sizes			All Lengths		50	(350)	24
Over 33	(230)	All Sizes			All Lengths		1.5 x the max. operating pressure		24
All welded pipe		All Sizes			All Lengths		The greater of 50 psig (350 kPa) or 1.5 x the max. operating pressure.		24

5.	Hydraulic Test Heating/Cooling:								
	a. Steam – Heating, Glycol – Cooling or Heating.								
	b. Whole System.								
	c. Section of System.								
	d. New pressure gauge, isolation valve.								
	e. System to maintain 860 KPA (125 psi) for four hours.								
6.	Hydraulic Test Steam: Condensate								
	a. Whole System.								
	b. Section of System.								
	c. New pressure gauge, isolation valve.								
	d. System to maintain 1200 KPA (175 psi) for four hours.								
7.	Compressed Air: Pressure Test								
	a. Whole System.								
	b. Section of System.								
	c. New pressure gauge, isolation valve.								
	d. System to maintain 1200 KPA (175 psi) for four hours.								
	e. Pressure drop not to exceed 10 KPA (14 psi).								
8.	Pneumatic Test Waste Oil Storage System:								
	a. Tank: New pressure gauge, isolation valve. Maintain 36 KPA (5 psi) for ten hours. All tappings soaped during test. Testing to manufacturer’s written procedure. Site to co-ordinate with CSA B13951 - 1982.								
	b. Piping System.								
	c. Whole System.								
	d. Section of System.								

		DATE CHECKED	COMMENTS
	e. New pressure gauge, isolation valve.		
	f. System to maintain 860 KPA (125 psi) for ten hours		
	g. All joints soaped during test.		
9.	Pneumatic Test Bulk Fuel Storage Tanks:		
	a. Tank New pressure gauge, isolation valve. Maintain a minimum of 10 KPA to a maximum of 35 KPA (5 psi) for one hour. All tappings soaped during test. * 15552 Field Quantity Control – safety valve set at 40 KPA (5.5 psi) to Manufacturer’s written procedure. Site to co-ordinate with CSA B13951 – 1982.		
10.	Pneumatic Test – Fuel Delivery:		
	a. Whole System.		
	b. Section of System.		
	c. New pressure gauge, isolation valve.		
	d. System to maintain working pressure of 1050 KPA (150 psi) for four hours without loss. Soap all joints.		
11.	Pneumatic Test Secondary Containment System:		
	a. Whole System.		
	b. Section of System.		
	c. 4 inch system test at 5 psi.		
	d. 6 inch system test at 3 psi.		
	e. Relief valve set at 6 psi.		
	f. Maximum duration of test at 45 minutes.		
12.	Duct Leakage:		
	a. Class 1: 0.5% of total system. Design L/S at 500 PA.		
	b. Test section minimum of 30 m long with not less than 3 branch take-offs and 2 – 90 degree elbows.		
	c. Install no additional ductwork until trial duct leakage test is accepted.		

	DATE CHECKED	COMMENTS
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REMARKS/COMMENTS:

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Mechanical Contractor:	Date:
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Departmental Representative:	Date:

DOMESTIC WATER PIPING INSPECTION FORM

PROJECT:	DATE	
FILE NO:	CHECKED	COMMENTS

A.	PIPING SUPPORTS:		
	(1) Verify hangers on copper pipe to be copper plated wrought steel or plastic coated.		
	(2) If supports are a dissimilar metal, ensure di-electric isolation (eg. Tape or Rubber)		
	(3) Ensure supports are properly spaced.		
B.	DOMESTIC PIPING SYSTEMS:		
	(1) Reducing bushings not permitted.		
	(2) Verify valves installed at following locations: a) Base of each riser. b) Each fixture supply c) Branch runs. d) On equipment/fixtures not furnished with own valve.		
	(3) Access doors of sufficient size are installed to service concealed equipment or valves.		
	(4) Must have Hose bibbs on all low points for complete drainage of system.		
	(5) Valves: no stem installed below horizontal.		
	(6) Balancing valves are installed where required.		
	(7) Unions or flanges are installed on any equipment or accessory that may require removal.		
	(8) Di-electric fittings are used to join copper pipe to a dissimilar metal pipe or fixture.		
	(9) Hydrostatic testing is complete (MV4-002) a) D.C.W piping b) D.H.W piping c) D.H.W recirculation piping		

REMARKS/COMMENTS:	

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

PLUMBING SPECIALTIES INSPECTION REPORT

	PROJECT: FILE NO:	DATE CHECKED	COMMENTS
A.	PRESSURE REGULATING VALVE:		
	(1) correct type		
	(2) properly installed		
	(3) direction of flow correct		
B.	CHECK VALVE:		
	(1) correct type		
	(2) direction of flow correct		
C.	BACKFLOW PREVENTORS:		
	(1) correct type		
	(2) properly located		
	(3) direction of flow correct		
D.	TRAP SEAL PRIMERS:		
	(1) properly installed		
	(2) water supply reliable		
	(3) accessible		

REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
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General Contractor / Consultant:	Date:
Departmental Representative:	Date:

FIRE PROTECTION INSPECTION FORM

PROJECT: FILE NO:	DATE CHECKED	COMMENTS
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A.	1. Piping is properly supported.		
	2. Piping has been tested (MV4-024).		
	3. Seismic attachments installed (if required).		
	4. Sleeves are sealed and pipe identified.		
	5. Verify type and quantity of heads in each location with Sprinkler Drawing.		
	6. Wire guards installed on sprinkler heads in storage rooms, under stair landings, and as required by NFPA 13.		
	7. Sprinkler riser has supervised shut-off valve with zone flow alarm for each zone.		
	8. Siamese connection location is correct and matches local fire department connection.		
	9. Water Gong location is correct.		
	10. Backflow prevention (check valve) installed in correct location.		
	11. Sprinkler alarm check valve and trim installed.		
	12. Air Compressor, or excess pressure pump installed.		
	13. All zone valves are tagged and tamper switches are wired.		
	14. Verify locations of and type of Fire Hose Cabinets,.		
	15. There is a flush connection (Inspectors test) at the end of each zone.		
	16. Signage and Identification is correct.		

REMARKS/COMMENTS:

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Departmental Representative:	Date:

THERMAL PIPING INSULATION INSPECTION FORM

PROJECT: FILE NO:	DATE CHECKED	COMMENTS			
A. System 1: Verify:					
1. Domestic Cold Water; 4 °C (39 °F)					
2. Chilled Water; 10 °C (50 °F)					
a) Rain water piping.					
b) Rigid mineral fiber.					
c) Vapor barrier jacket. Refer to specification.					
<u>Thickness Schedule</u>					
Paper Size	<u>25mm Under</u>	<u>30/50</u>	<u>65/100</u>	<u>125 Up</u>	
Cold water:	13	25	25	25	
B. System P1: Verify:					
1. Roof drain body.					
2. Rain water piping 5m from body.					
3. Mineral fiber blanket.					
4. Vapor barrier jacket.					
5. Thickness: 25mm. Refer to specification.					
C. System P2: Verify:					
1. Refrigeration Suction and Hot Gas Lines. Flexible unicellular sheet pipe covering.					
<u>Thickness</u>					
<u>1 ½" and under</u>		<u>2 – 3"</u>			
9mm (1/4")		12mm (1/2")			
F. Handicap Lavatory Services: Refer to specification.					
Verify:					
1. Sanitary drain, including trap to wall					
2. Hot/Cold domestic piping, wall to fixture					
3. Material: Thickness: 25mm					
a) Flexible closed cell polyethylene					
b) Fastenings: contact adhesive finished with vinyl lacquer coating glossy.					
G. Cold and Hot water Equipment: Refer to specification					
Verify:					
1. Domestic hot water storage tank					

THERMAL PIPING INSULATION INSPECTION FORM Cont'd		DATE CHECKED	COMMENTS
	2. Material:		
	a) Flexible glass fiberboard		
	b) All service jacket		
	c) Foil/draft paper laminate		
	d) Fastenings: flared staples, annealed wire and straps at 13mm wide with buckles.		
	e) Provide canvas jacket.		
	Refer to specification		
H.	Field Check:		
	1. Systems P1, and P2, lagging adhesive, fire retardant coating.		
	2. System P4 contact adhesive, tape self adhesive PVC.		
H.	Field Check: Cont'd		
	3. Jackets, canvas in exposed areas with 120 @/M2 cotton fabric on concealed valves and fittings.		
	4. Outdoors, aluminum alloy embossed jacket with factory applied protective liner, 50mm lap ends with butt straps, mechanical fasteners. Fittings die-shaped protective liner.		
	5. Roof drain body, mineral fiber blanket, (25mm) vapor barrier, contact adhesive, 100% coverage, tape self-adhesive PVC.		
	6. Secure pipe insulation with tape at each end, and center of each section.		
	7. Vapor barrier, insulation not broken, continuous over full length of system, not broken or penetrated by sleeves, hangers or rod.		
	8. Exposed ends or terminations sealed with insulating cement.		
	9. Tie-ins to equipment, valves and unions are to be easily disassembled of covering with no damage to adjacent insulation.		
	10. A 1.6mm rubber type gasket must be installed between pipe support shield and insulation.		
	11. On all exposed piping passing through floors, the insulation shall be protected with 1.2mm galvanized jacket to 600mm above finished floor.		
	12. Workmanship.		

THERMAL PIPING INSULATION INSPECTION FORM Cont'd	DATE CHECKED	COMMENTS
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REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

DUCTWORK INSPECTION FORM

PROJECT: FILE NO:	DATE CHECKED	COMMENTS
A. LOW PRESSURE - Refer to specifications		
(1) Provide watertight duct for fresh air intakes.		
(2) Minimum 3000mm from duct mounted humidifier in all directions.		
(3) <u>Application:</u> Slope to exterior walls.		
(4) Locking nuts and washers.		
(5) Do not break continuity of insulation vapor barrier with hangers or rod.		
(6) Insulate strap hangers 100mm beyond insulated duct.		
(7) See 2.10 (i.e.) black steel rods to ASHRAE and SMACNA is incorrect as both of these agencies standard is galvanized”.		
B. FLEXIBLE DUCTWORK - Refer to Specifications.		
(1) Flexible ductwork not to exceed 1m.		
(2) Ducts to be continuous; no intermediate joints.		
(3) Support to suit length.		
(4) Smooth bends, no kinks.		
C. FLEXIBLE CONNECTIONS – Refer to Specifications		
(1) Fire resistant neoprene coated glass fabric.		
(2) Fabric clenched by double lock seams.		
(3) Length of connection 150mm.		
(4) Minimum distance between metal seams when operational 75mm; sufficient slack to prevent vibration transmission.		
(5) Locations; outlets from supply air units outlets on exhaust and return air fans.		
D. SEALANT TAPE – Refer to Specifications		
(1) Verify sealant oil resistant, polymer type, flame resistant.		
(2) Verify tape polyvinyl treated, open weave glass, 50mm wide.		
(3) Verify application: Bed tape in sealant.		
(4) Re-coat with sealant.		
(5) No voids, good adhesion.		
(6) Not applied to dirty or grease surfaces.		
E. ACCESS DOORS – Refer to Specifications		

DUCTWORK INSPECTION FORM Cont'd		DATE CHECKED	COMMENTS
	Verify Hardware:		
	(1) up to: 300mm x 300mm: 2 sash locks		
	(2) 301mm x 450mm: 4 sash locks		
	(3) 451mm x 1000mm: piano hinge plus minimum of 2 sash locks.		
	(4) 1000mm: piano hinge and 2 handles that are operational from both sides.		
	Verify size:		
	(1) 300mm x 300mm for viewing		
	(2) 400mm x 400mm for servicing		
	(3) 600mm x 600mm for body entry		
	(4) Verify this requirement with Contractor prior to installation.		
	(5) Review contract drawings – are the other sizes Indicated?		
	Verify Location at:		
	(1) Fire Dampers, Control Dampers, Maintenance		
	(2) Components or Devices, Code Locations		
F.	INSTRUMENT TEST PORTS – Refer to Specifications		
	a. Verify:		
	(1) Zinc plated		
	(2) Cam lock		
	(3) Neoprene expansion plug complete with handle		
	(4) Mounting Gasket		
	(5) 1P1-1P2 for mounting to duct surface or stand off mounting on top of thermal duct insulation.		
	(6) Insulation port extensions where required		
	b. Locations: Coordinate with balancer for exact location		
	(1) Normally locations are for traverse readings		
	(2) Temperature readings		
	(3) Downstream of converging air streams		
G.	VERIFY ACCOUSTIC DUCT LINING – Refer to Specification		
	(1) Duct dimensions on the drawings are net, inside dimensions.		
	(2) Secure insulation to duct with fire resistant Adhesive, welded pins and clips on 400mm centers		
	(3) Seal all joints, exposed edges and damaged areas of liner with joint tape; apply two coats of sealer over tape.		
	(4) Badly damaged lining to be replaced at discretion of departmental representative.		
	(5) Protect leading and trailing edges with sheet metal edging.		
H.	DAMPERS – Refer to Specifications		

DUCTWORK INSPECTION FORM Cont'd	DATE CHECKED	COMMENTS
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	(1) Sized to maintain full flow cross-section.		
	(2) Provide complete with frame and 40mm x 40mm x 3mm angle iron on full perimeter of frame both sides of barriers pierced.		
	(3) Verify operation of fire dampers, install access door adjacent to each damper.		

REMARKS/COMMENTS:

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Mechanical Contractor:	Date:
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Departmental Representative:	Date:

THERMAL DUCTING INSULATION INSPECTION REPORT FORM

PROJECT:	DATE CHECKED	COMMENTS
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A.	Ducting to be insulated. Ref 15270		
	.1 All new supply duct connected to new air handler where shown on drawings 1.1 / .4		
	.2 All new Fresh air intake duct back to unit. 3.1 / .6		
	..3 All new exhaust duct back to damper. 3.1 / 6		
B.	Supply duct insulation Ref 15270 1.1 /4		
	.1 25 mm thick external insulation		
	.2 Refer to section 2.1 to 2.4		
C.	Fresh air intake and Exhaust duct. Ref 15270		
	.1 Refer to sections 3.1 to 3.2		
D.	Installation		
	.1 Installed in accordance with ANSI/NFPA 90A-1993 and ANSI/NFPA 90B=1993 Ref to sec 3.2 / .1		
E.	Mechanical Fastenings ;		
	.1 Refer to sec 3.2 / .2		
F.	Canvas Jacketing (type J1)		
	.1 Refer to section 3.2/ .3		
	a)		

FACTORY TEST COMMERCIAL FANS INSPECTION FORM

PROJECT: FILE NO:	DATE CHECKED	COMMENTS
A. General Information:		
1. Test each supply and return fan to meet all design conditions.		
2. All tests shall be conducted in the fan manufacturer's laboratory as scheduled by contractor who will provide:		
a) 5 days of working notice to Departmental Representative of scheduled test date and time.		
b) Test performance data of each fan test shall be submitted to Departmental Representative for their comments.		
c) Contractor will liaison with fan manufacturer to resolve problems that arise during or after factory test prior to shipment of fans to site.		
3. Refer to the Contract Drawing re: the number of people that will witness test on behalf of Departmental Representative.		
REMARKS/COMMENTS:		
ACKNOWLEDGED:	DATE	
Mechanical Contractor:	Date:	
General Contractor / Consultant:	Date:	
Departmental Representative	Date:	

FIRE DAMPER INSTALLATION PRIOR TO CONCEALMENT FORM

PROJECT:
FILE NO:

SYSTEM	LOCATION	SIZE	CAN FIRE DAMPER BE RESET?	ACCESS DOOR	UL LABEL	FIRE STOPPED	DATE OF INSPECTION

REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

AIR TERMINAL BOX INSTALLATION INSPECTION FORM

PROJECT:
FILE NO:

BOX NO.	LOCATION	DAMPER CONTROLLING	AIR FLOW L/S		SENSOR INSTALLED	DATE OF INSPECTION
			MAX	MIN		
1						
2						
3						
4						
5						
6						
7						

EMCS INSTALLATION INSPECTION FORM

	PROJECT: FILE NO:	DATE CHECKED	COMMENTS
A.	Verify sensors are readily accessible and adaptable to each type of transmitters in such a manner that allows for quick, easy replacement and servicing without special tools.		
B.	Outdoor installation shall be weatherproof construction in NEMA 12 enclosures. Protect from solar radiation and wind effects by stainless steel shields. Refer to contract documents.		
C.	Wells for temperature sensing devices shall not restrict flow area to less than 70% of normal line size flow area. Wells should be installed in the piping at turns to enable proper liquid flow across the entire surface of the well.		
	Verify damper operator location and mounting arrangements.		
D.	Locate all sensors, devices and controllers where accessible. Review on site prior to acceptance tests.		
E.	Verify all temperature control wiring 50 volts or more shall be a minimum of #14 gauge wire. All temperature control wiring less than 50 volts shall be minimum #18 gauge wire. (Review contract documents). Obtain samples and verify with wire gauge.		
F.	All wiring shall be in conduit and following building lines. Electrical materials and installation shall be as specified and in accordance with the local electrical code and inspection authority. (Refer to electrical specification).		
G.	All temperature sensor wiring and communications buses must be run separate from any line voltage and shielded to prevent interference from 60 cycle noise. (Refer to specification).		
H.	To remove the detrimental effects of ground looping or lightning strikes, all panels that require 120 VAC must be connected to a true earth ground. Panel grounding to structural steel or cold water piping is not acceptable. (Refer to specification).		
I.	All controllers that are utilizing line voltage (120 VAC) as their main power source shall require power line conditioning (Surge Suppression) devices. (Refer to specification).		
J.	To minimize "NOISE" at a remote terminal, all modem connections to have telephone line conditioning equipment. The conditioning equipment shall have both noise and spike suppression rated at 26,000 AMPS for 20 microseconds (IEEE Standard 8) or 280 kW for 1 Millisecond. (Refer to specification).		
K.	NAMEPLATES		

EMCS INSTALLATION INSPECTION FORM Cont'd	DATE CHECKED	COMMENTS
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	a) Verify each duct and pipe mounted sensor or control devices are clearly identified by a permanently mounted nameplate. (Refer to specification).		
	b) Locate nameplates in a conspicuous location.		
	c) Provide a list of all wording proposed for nameplates along with sample of same for review by departmental representative. (Refer to specification).		
	d) Verify nameplates are: 1. 25mm high, white lamacoid with contrasting 12 mm high black lettering.		
	2. Minimum size is 25mm x 65mm.		

REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

EMCS STARTUP VERIFICATION FORM

PROJECT: FILE NO:	DATE CHECKED	COMMENTS
A. General Information Only:		
Obtain I/O Summaries and Extended I/O Summaries. Obtain Electronic copy of EMCS Specification.		
B. Execution of Sequence:		
1. Clean controller panel as required.		
2. Inspect all wiring termination and connections (pneumatic, electrical, electronic).		
3. Inspect all terminations and connections.		
4. Inspect operation of valve actuators and motors.		
5. Inspect remote device field mountings.		
6. Verify power supply AC mains.		
7. Verify DC power supply voltages.		
8. Exercise applicable software command functions. (I/O SUMMARIES)		
9. Verify displays and printouts.		
10. Verify analog inputs, outputs and totalizer points. (I/O SUMMARIES)		
11. Test output commands and analog output points. (I/O SUMMARIES)		
12. Test start/stops and alarm programs. (I/O SUMMARIES)		
13. Modify (manual) status and check overrides.		
14. Trip remote alarm and verify alarm display.		
15. Check programmed start/stops. (I/O SUMMARIES)		
16. Check all sensors/controllers and calibrate where applicable. (I/O SUMMARIES)		
17. Check all analog output transducers and calibrate where applicable.		
18. Check and set real time clock and clock reset function.		
19. Verify "Printer Operation" (if specified).		
20. Verify fully programmable Indoor-Outdoor temperature reset control.		
21. Verify each mechanical room has a connection point for a lap top computer to allow access info. And system controls linked on the communications network.		
22. Verify provision of 28,000 band dial out modem for remote alarm reporting.		
23. Verify specific configuration for each controller and test to ensure Compliance with the sequence of operation.		
24. If the controller has sequences performed by another control device all local control sequences are tested first then the remote or global programming is verified when the entire control system is established.		
25. Any additional feature such as schedules, demand limiting, optimal stop/start, trending totalization and graphics are added and verified as the final step.		

EMCS STARTUP VERIFICATION FORM Cont'd

REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
EMCS Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

EMCS FUNCTIONAL & FINAL COMMISSIONING TESTS FORM

PROJECT: FILE NO:	DATE CHECKED	COMMENTS
A. General Information Only:		
Final commissioning verification phase. Final phase is accomplished by the start up of the system or systems performing all necessary testing while diagnostics run ensuring proper operation. This is performed at time of final acceptance.		
B. Execution of Sequence:		
Hardware Point Testing:		
1. a) Digital output status shall be verified at the equipment location.		
b) Verification at Central location should be completed for "ON" status, "OFF" status, software disabled indicator and overridden indicator.		
2. a) All analog outputs shall be tested by sending a command from the "Central" to stroke the device from closed to open.		
b) Measuring pressure and/or voltage.		
c) The increments of the test should be either 2 MA or 1 Volt depending on the device. (Refer to shop drawings).		
3. Digital input status shall be verified at the central for "ON" status and "OFF" status.		
4. All digital alarm inputs shall be jumpered at the field device to test for correct notification at the central.		
5. All temperature sensors must be verified by conducting an equivalent test using a digital hand-held meter, accuracy of meter should be equal or better than sensor.		
6. Verify "Hi", "Low" limit controls.		
7. All pressure sensing devices to be measured using a device with equal accuracy to ensure correct calibration.		
8. All humidity sensing devices to be checked. Use a humidity sling or humidity meter to verify sensor accuracy. Calibration as required.		
9. ON LINE SOFTWARE TESTING.		
a) With points enabled and automatically controlled, systems and associated programs must operate for specified length of time.		
b) On a history log to verify all types of conditions that occurred in the period.		
c) A system is considered commissioned when all alarms and system values are appropriate for the control sequence.		
10. History logs must be submitted to the Consultants and Commissioning Agent.		
C. Final Commissioning:		
<i>Attach Non Conformance Reports to this from. (Admin 4-034)</i>		

EMCS STARTUP VERIFICATION FORM Cont'd

REMARKS/COMMENTS:

ACKNOWLEDGED:

DATE

EMCS Contractor:

Date:

General Contractor / Consultant:

Date:

Departmental Representative:

Date:

EMCS CONTROL UNIT – LOCAL STAND ALONE FUNCTIONAL TEST FORM

PROJECT: FILE NO.:	DATE CHECKED	COMMENTS
A. (1) Provide 5% spare capacity in each.		
(2) “SCU” to have battery backup capable of supporting all memory within the control unit for a minimum of “8” hours. Refer to specification.		
B. The “SCU” contains two ports which allows various user Interface providing communications over the total “SCU”: Network. The following functions may be performed:		
(1) Display all points status report.		
(2) Display alarm report.		
(3) Add, change or delete points.		
(4) Change set points.		
(5) Add, change or delete custom control sequences.		
(6) Command points to specific state.		
(7) Collect and display historical trend information for multiple points.		
C. Each Stand Alone “SCU” to contain the following software as a minimum:		
(1) Operating system software, hardware control logic necessary for the Management of the Control system.		
(2) Operator system communication software.		
(3) Point database software.		
(4) Report software.		
(5) Alarm and monitoring software.		
(6) Network software.		
D. Controls to go to fail-safe condition on equipment or software failure.		
E. “SCU” to be capable of performing the following energy management functions:		
(1) Time of day scheduling.		
(2) Start/stop time optimization.		
(3) Peak demand limiting (future).		
(4) Duty cycling (future).		
(5) Economizer control (future).		
(6) Outdoor air reset		
(7) Event initiated programs		
F. To permit the generation of control strategies that can be activated in any of the following ways:		
(1) Continuously.		
(2) At a particular time of day.		
(3) Pre-defined date.		
F. Cont’d		
(4) When a specific measured or controlled variable reads a selected value of state.		

EMCS CONTROL UNIT – LOCAL STAND ALONE FUNCTIONAL TEST FORM Cont'd	DATE CHECKED	COMMENTS
(5) When a piece of equipment has run for a certain Period of time.		
G. “SCU” report software to produce the following reports:		
(1) Summary of current values of all analogue inputs necessary for controlling and alarming.		
(2) Summary of points currently in alarm.		
(3) Summary of assigned high and/or low alarm limits as outlines.		
(4) Summary of disabled alarm points.		
(5) Summary of instructions listings for all points DCC programs.		
(6) Trend data on a time basis for all points being monitored and on a change value basis for all alarm points.		
H. Each “SCU” to contain all operator/system communication Software to permit the following:		
Operator communication as a minimum through use of a hand-held terminal, or Printer.		
(1) Obtain information on system performance.		
(2) Allow operator to revise system sequence of operation.		
(3) Diagnosing system malfunction.		
Execution of point database, report, alarm and “Monitor in energy Management” DCC software.		
I. (1) LEVEL ONE – Request reports, acknowledge alarms and perform departmental representative’s defined commands.		
(2) LEVEL TWO – The above plus, modify database, create, execute and modify direct digital control programs.		
(3) LEVEL THREE – The above plus, assign Passwords.		
J. Management Functions:		
(1) Alarms: Hard copy.		
(2) Hard copy of all points.		
(3) Hard copy of trend log report.		
Activity report on:		
(1) consumption demand.		
(2) Peak demand.		
(3) Set point data.		
(4) Sent via hard copy to printer		

REMARKS/COMMENTS:

ACKNOWLEDGED:

DATE

Electrical Contractor:

Date:

General Contractor / Consultant:

Date:

Departmental Representative:

Date:

MECHANICAL EQUIPMENT SPARE PARTS REPORT

PROJECT:
FILE NO:

A.	GENERAL INFORMATION:
	(1) EQUIPMENT DESCRIPTION:
	(2) SPECIFICATION REFERENCE:
	(3) PARTS:
	(4) NAME OR ORIGINAL MANUFACTURER:
	(5) MANUFACTURER'S PART/REFERENCE NUMBER:
	(6) HOW PACKAGED AND IDENTIFIED:
	(7) SEQUENTIAL LIST OF ACTIVITIES REQUIRED TO PERFORM REPLACEMENT TASKS:
	(8) ESTIMATE OF TIME FREQUENCY FOR PART REPLACEMENT IN MAN DAYS:
ADDITIONAL REMARKS/COMMENTS:	
ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

BALANCING PRELIMINARY PROCEDURES REPORT FORM

PROJECT:	VERIFY	
FILE NO:	CONFORMANCE	COMMENTS

A.	Contractor to be a certified member of Specified Council or Testing Association, and shall verify prior to starting TAB which association they will balance to.		
B.	Prior to start, this contractor shall make the specified number site inspections before and during construction and shall advise both the departmental representative, prime mechanical contractor and general contractor of any adjustments, changes or retrofit to any system whole or part that are required for balancing.		
C.	Provide proof that instrument calibration has been performed within 3 months previous to this contract's balancing.		

INSTRUMENT LIST

	INSTRUMENT	MANUFACTURER	MODEL	SERIAL NUMBER	RANGE	CALIBRATION DATE
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						
9.						
10.						
11.						
12.						

REMARKS/COMMENTS:

Submit letters of proof, complete with calibration costs to Departmental Representative.

ACKNOWLEDGED:

DATE

Mechanical Contractor:

Date:

General Contractor / Consultant:

Date:

Departmental Representative:

Date:

FACTORY APPLIED PROTECTIVE COATINGS INSPECTION FORM

PROJECT: FILE NO:		DATE CHECKED	COMMENTS
A.	Inspection:		
	a. The supplier shall notify the departmental representative two weeks before commencing the protective coating in order to facilitate the inspection by the departmental representative of the surface preparation and protective coating application.		
B.	Protection:		
	a. All coated equipment shall be protected adequately against damage, dust, moisture and scratching during shipment, off-loading and storage on site. If, in the opinion of the departmental representative, the coating is damaged during shipment to the extent that touchup would not be satisfactory, the equipment shall be returned and recoated at no cost to the departmental representative.		
C.	Surface Preparation:		
	a. Immersion Service: After degreasing, all ferrous components shall be dry blasted to a white metal finish in accordance with SSPC – SP5 to a degree of cleanliness in accordance with NACE # 1 and obtain a 50-micron blast profile.		
	b. Non-immersion Service: After degreasing, as a minimum all surfaces shall be hand tool cleaned in accordance with SSPC – SS2 or power tool cleaned in accordance with SSPC – SS3.		
D.	Prime Coating and Finish:		
	a. All ferrous surfaces are to be coated before the blasted surfaces deteriorate.		
	b. All ferrous surfaces are to be coated with inorganic zinc primer, containing a minimum of 50% solids by volume, applied to a minimum dry film thickness of 75 micron.		
	c. Finish coat as per 14901 services, coating types and application rates using industrial enamel coal tar, epoxy bituminous paint, silicone enamel or epoxy glass enamel.		
E.	Assembly:		
	a. Items, which are to be bolted together before shipment, shall have their surfaces cleaned and coated before the parts are assembled.		
	b. All welded connections are to be continuous weld, sealing the mating surface completely. On completion of the welding and fettling all weld seams are to be treated with phosphoric acid solution, rinsed and thoroughly dried before the primer is supplied.		
	c. Where dissimilar metals are mated, the surfaces shall be insulated from one another to provide protection against galvanic or other corrosion.		

FACTORY APPLIED PROTECTIVE COATINGS INSPECTION FORM Cont'd	DATE CHECKED	COMMENTS
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	d. All nuts, bolts, washers and similar fittings for immersion service shall be 304 stainless steel or better. Nuts, bolts, washers, and similar fittings for non-immersion service shall be 304 stainless or zinc plated. The inner faces of boltholes, not threaded, are to be cleaned and coated as required for other surfaces.		

REMARKS/COMMENTS

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

PLUMBING: SANITARY DRAINS, ROOF DRAIN & VENTS INSPECTION REPORT

PROJECT: FILE NO.:		DATE CHECKED	COMMENTS
A.	PIPING:		
	(1) grades in appropriate direction		
	(2) correct material		
	(3) is properly supported		
	(4) all fixtures are properly vented		
	(5) roof drains are properly connected to rain water leaders		
	(6) piping has been tested (MV4-024) <ul style="list-style-type: none"> - sanitary drains - roof drains - vents 		
B.	CLEANOUTS:		
	(1) are installed at base of all vent stacks and rainwater leaders in addition to those required by code.		
	(2) cleanouts are at finish floor level or inside face of walls		
	(3) there are access covers at all cleanouts		
REMARKS/COMMENTS:			
ACKNOWLEDGED:		DATE	
Electrical Contractor:		Date:	
General Contractor / Consultant:		Date:	
Departmental Representative:		Date:	

PLUMBING: UNDERGROUND SERVICES VERIFICATION FORM

PROJECT: FILE NO.:		DATE CHECKED	COMMENTS
1.	<u>SANITARY DRAINS</u>		
	(1) Pipe material identification is clearly visible.		
	(2) Material meets N.B.C. requirements (i.e. pvc pipe must be CSA-B181.2).		
	(3) Fittings must be long radius bends.		
	(4) Ensure pipe is pushed into fitting to the guide mark.		
	(5) Test at 5 ft. head min. for 15 minutes and document test on MV4-002.		
	(6) Verify that piping has proper slope.		
	(6) Verify that cleanouts are installed to code and accessible.		
	(7) Verify that trap seal primers are installed and tubing is not kinked.		
	(8) Verify that no floor drains have been missed.		
	(10) Record invert elevation on drwg.		
2.	<u>DOMESTIC WATER</u>		
	(1) Pipe material identification is clearly visible		
	(2) Material meets N.B.C. requirements (i.e. Pvc pipe must be CSA-B137.3)		
	(3) Ensure that pipe is pushed into fitting to the guide mark (4" pvc + up)		
	(4) Thrust blocks and/or retaining rods are correctly installed (ie. Joints are not covered up)		
	(5) Thrust blocks must have set for 48 hours min. before pressure testing		
	(6) Whatever material is used underground must come up into the building at least 11" but not more than 18".		
	(7) When using ABS or PVC pipe a tracer wire (#14 gauge) must be installed following the piping.		
	(8) Ensure that isolating valves are installed as per spec. & drwgs.		
	(9) Piping to be tested at 145 PSIG (Hydrostatic) for 1HR. min. or at 102 PSIG (Pneumatic) for 2 HR. min. (if ambient temp. is below freezing) use MV4-002 to document test.		
	(10) Piping is clean and flushed.		
	(11) Record invert elevation on drawing.		

PLUMBING: UNDERGROUND SERVICES VERIFICATION FORM Cont'd	DATE CHECKED	COMMENTS
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REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Electrical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

CONTROLS & INSTRUMENTATION FORM

PROJECT: FILE NO:	DATE CHECKED	COMMENTS
A. GENERAL (1) REFERENCE a) This section of the Specification is an integral part of the Contract Documents and shall be read accordingly.		
b) Comply with Division 1 - General Requirements- and documents referred to herein.		
c) Conform with the requirement of Section 15010, Mechanical General Provisions.		
(2) RELATED WORK Basic Materials and Methods Section # Liquid Heat Transfer Section # Air Distribution Section #		
(3) HANDLING AND STORAGE OF MATERIALS a) Materials shall be stored in such a manner so they will not be damaged due to moisture or site activity. b) All damaged material is to be removed from site. c) All material and equipment shall be protected from damage before, during and after construction.		
(4) GENERAL a) The work shall include design, supply, installation and commissioning a complete microprocessor based automatic control system to achieve the performance specified in the following clauses. b) Visit the site prior to tender to become familiar with field conditions and existing equipment. c) The control system shall be installed by the control subcontractor but as an integral part of the mechanical sub-contract. The system shall be installed by trade certified electricians regularly employed by the control sub-contractor. d) The controls contractor will specifically read all mechanical and electrical drawings, specifications and addenda and determine the controls work provided by the mechanical contractor, his sub-contractors, and the electrical contractor. The controls contractor is expected to have the expertise to coordinate the		

CONTROLS & INSTRUMENTATION FORM Cont'd	DATE CHECKED	COMMENTS
	<p>work of other contractors and to make a completely coordinated Building Automation Control System (BACS) for the mechanical systems. The controls specifications are specifically written to coordinate the mechanical and electrical systems. Where others are specifically specified to allow for controls work, then the BACS contractor will not allow for that work. This clause is not intended to make the controls contractor responsible for work not specified, but to make the BACS contractor responsible for examining the specifications for contradictions and overlap.</p>	
(5) SCOPE	<p>a) This project includes the following work:</p> <ul style="list-style-type: none"> .1 Preparation of control shop drawings for review. See Submittals. .2 Provide control components. See Field Devices. .3 Provide a network of Direct Digital Control (DDC) panels. See Hardware. .4 Provide graphics software, system software, and third party software as specified. See Software. .5 Wiring of the DDC controls system. See Installation. .6 Calibrate and commission the installed controls system. See Calibration. .7 Provide maintenance manuals and as built drawings. See Submittals. .8 Provide training of departmental representative's operators. See Scope below. .9 Provide a three-year warranty on all components. See Scope below. 	
	<p>.2 The BACS contractor shall provide the necessary engineering, installation, supervision, commissioning and programming for a complete and fully operational system. The contractor will provide, as many trips to the job site for installation, supervision, and commissioning as are necessary to complete the project to the satisfaction of the consultant.</p>	
	<p>.3 The system shall consist of all operators interfaces, microprocessor-based controllers, sensors, wells, automatic control valves, control dampers, transducers, and relays, automatic control valves, and damper actuators.</p>	

CONTROLS & INSTRUMENTATION FORM Cont'd		DATE CHECKED	COMMENTS
	<p>.4 Provide all the necessary software and interface devices for DDC-based of the following systems:</p> <p>(i) AHUs and RTUs (ii) Room temperature control (iii) Hydronic heating system controls (iv) Exhaust fans</p>		
	<p>.5 The following systems may be controlled by independent electrical controls:</p> <p>(v) Exhaust fans on local timers or cooling thermostats (vi) Remote wall fin radiation (vii) Unit Heaters</p>		
	<p>.6 At the completion of the installation and immediately following commissioning, provide a two (2) day training session on site to the departmental representative's designated personnel.</p>		
	<p>.7 Check sensor calibration and control system operation during the first heating season and prior to the first cooling season. Following each visit:</p> <p>.1 Provide printed graphs of trend logs that are one week in duration and have hourly samples for all analog inputs connected to each controller.</p> <p>.2 Update the printed and diskette copies of any changes made to programs for any controller.</p>		
	<p>.8 Warranty all components supplied under this contract for a period of one year from substantial completion. Replace all controls equipment that fails during this period.</p>		
	<p>1.7 DEPARTMENTAL REPRESENTATIVES' DEMONSTRATION AND INSTRUCTION PERIOD</p> <p>.1 Demonstrate and confirm that all systems are programmed and operating correctly.</p> <p>.2 Submit diskettes (including back-up diskette in lockable case) containing up-to-date copies of the programs in each controller. Provide original program disks and documentation proving registration for all software programs provided as part of</p>		

CONTROLS & INSTRUMENTATION FORM Cont'd	DATE CHECKED	COMMENTS
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REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

MOTOR STARTER AND CONTROL LIST FORM

PROJECT:
FILE NO:

"SAMPLE ONLY"

To be submitted at Program Stage

(Design/Build or Design Brief)

SEQUENCE OF OPERATIONS FOR CONTROL SYSTEMS

PROJECT:
FILE NO:

"SAMPLE ONLY"

To be submitted at Program Stage

(Include in Consultant's Design Brief)

I/O POINTS AND SCHEMATICS FORM

PROJECT: FILE NO:

"SAMPLE ONLY"

To be submitted at Program Stage

(Design/Build or Design Brief)

AIR HANDLING SYSTEM OPERATIONS OUTLINE

PROJECT:
FILE NO:

"SAMPLE PROVIDED FOR REFERENCE ONLY"

Contractor to provide actual Operations Outline

AIR HANDLING SYSTEM OPERATIONS OUTLINE Cont'd	DATE CHECKED	COMMENTS
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SAMPLE ONLY

Name of Project

Air Handling System Operations Outline

1. INTRODUCTION

----- has been retained by the Department of National Defence, , to prepare Contract Documents for the upgrade of ventilation systems serving ----- The following outline has been developed to provide background information as an aid to the Commissioning Team in completing the project in accordance with the design intent.

The renovation work detailed in the Contract Documents is primarily intended to improve the performance of the building ventilation systems by undertaking relatively minor renovations and a minimum of new construction. There has been a long history of contaminant flow from the garage (diesel engine fumes, etc.) into the office areas. This problem has persisted since the building was first occupied and has been compounded by a failure of the original pneumatic control system serving the building. This resulted in loss of control over basic system functions, rendering the relatively complex air handling system ineffective.

This outline presents a broad overview of the role of each air system serving this facility and a description of how the systems are to be operated and controlled to ensure that the desired improvement in ventilation system performance are achieved.

2. SYSTEMS DESCRIPTION

2.1 Existing System Overview

Building E-30 McNaughton primarily serves as a vehicle and equipment maintenance and warehousing facility, with a limited amount of formal office space. The existing air handling system configuration includes a number of indoor units (SF-1, 2, 3, 4 & 5) serving both the west-facing two storey office area and the north and south perimeter equipment maintenance/warehouse spaces. All but one of the indoor units (SF-1) is tied to a common return air plenum, from which air is transferred directly to the garage through a relief fan (RD-1). A total of three rooftop make-up air units (SF-6, 7 & 8) provide ventilation to the large centrally located vehicle service bay area. The facility is also served by a large number of exhaust fans which operate either on an "as required" basis or throughout the occupied period.

All air heating is accomplished through steam coils mounted in the rooftop and indoor units. Some of the indoor units (SF-3 and 5) are not equipped with heating coils and are unable to provide substantial ventilation air during cold weather. The return air transferred to the garage by RF-1 was intended as a heat recovery measure. Since the amount of outside air entering the building is not regulated or monitored effectively, this system tends to pressurize the garage relative to the office spaces. This causes the migration of contaminated air from the garage into the office as the pressure tries to equalize. This situation has been exacerbated by the lack of direct air supply into the office areas, caused by the failure of most of the VAV bypass boxes in the bypass mode.

AIR HANDLING SYSTEM OPERATIONS OUTLINE Cont'd	DATE CHECKED	COMMENTS
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2.2 Ventilation System Modifications

The current project is intended to correct a broad range of deficiencies in the ventilation system. The largest single change will result from the completion of the conversion of all major control functions from pneumatic to electronic DDC. These functions will now be controlled through the building automation system, allowing system performance to be monitored and controlled remotely. While some of this work has been carried out under separate projects, the commissioning process to be completed under this project will serve to prove-out all of the changes implemented at this facility.

The garage ventilation system originally relied heavily on the transfer of exhaust air from the office space to provide make-up air to the garage. In practice, the office systems have been incapable of meeting this demand, particularly during cold weather. In order to address this issue, the operation of existing steam heated rooftop make-up air units (SF-6, 7 and 8) is to be improved and new gas fired rooftop make-up air units (SF-15 and 16) will be added. These changes, along with the installation of new roof mounted exhaust fans (EF-30, 31, 32, 33 and 34) will increase garage ventilation rates in keeping with current garage ventilation standards.

The air distribution system serving the garage area is to be reconfigured to supply fresh air at low level and exhaust at high level. This "displacement" ventilation approach will improve control of engine exhaust fumes associated with vehicles moving through the facility by removing the fumes from the building as they rise to the ceiling upon release. The fresh air supply will be discharged at low level, displacing contaminants and providing clean air to occupants working at floor level. In addition, dedicated vehicle and engine testing exhaust systems are being upgraded to reduce the direct emission of engine fumes into the garage. This work includes the replacement of existing exhaust fans (EF-35 and 36) and the addition of a new generator test area exhaust system (EF-37).

The heating systems serving the garage and adjacent maintenance/warehouse areas have generally performed poorly. Supplemental heating, in the form of gas fired unit heaters, has been added near overhead doors in high traffic areas of the garage. The natural gas piping network has been sized to accommodate the installation of additional heaters in other areas as funding becomes available.

Other remedial measures to be implemented under this project include the addition of new return ductwork from the ceiling of the ground floor office space to the main return plenum and the extension of the supply ductwork system serving the areas adjacent to the garage. The new return ductwork is intended to provide a direct air return route from the ground floor office space. The extensions to the supply air system will resolve shortcomings associated with new partition layouts and provide pressurized buffer zones in vestibule areas between the garage and the office space at the west end of the building.

The installation of the new air conditioning unit (ACU-1) to serve the second floor auditorium is intended to allow this space to be operated independently of the remainder of the facility. This unit will be equipped with a gas fired heating section and an electric cooling section. This unit will be capable of providing comfort control and ventilation throughout the year.

Modification to the existing air handling systems will include balancing, re-configuring the control sequence for many of the systems and the repair/upgrade of VAV bypass box controls. The widespread failure of the VAV boxes has resulted in a complete lack of air movement in office areas. The repair of these boxes, combined with re-balancing air flows to occupied areas, will have an immediate and positive impact on occupant comfort.

AIR HANDLING SYSTEM OPERATIONS OUTLINE Cont'd	DATE CHECKED	COMMENTS
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3. Building Pressurization Control Strategy

As stated previously, the primary goal of this retrofit project is to improve the performance of the building HVAC systems. It is intended that the building occupants perceive the improvements in terms of the following:

- Improved air movement throughout the facility, particularly in the office areas.
- A significant reduction in the frequency and intensity of engine exhaust fume contamination events in the office areas.
- General air quality improvements in the garage area (i.e. reduced haze and noxious gas concentration).
- More consistent heating mode temperature control in perimeter areas of the office and maintenance/warehouse areas. Since cooling will not be provided in the majority of areas, space temperatures in the summer will remain high in most areas. This will be mitigated somewhat by improved air movement and the ability to cool the building at night through economizer operation.

In order to ensure these perceived improvements are realised, it is imperative that the systems be commissioned successfully, with particular emphasis placed on controls and balancing work outlined in the Contract Documents. The majority of the measures being implemented under this project are intended to improve ventilation system performance throughout the facility and allow the office spaces to operate at a net positive pressure relative to both the garage area and the outdoors. The positive pressure in the office spaces provides two major benefits in reducing infiltration rates during the winter season (which has often resulted in freeze-ups of the perimeter heating system) and ensuring contaminants from the garage do not enter the office spaces.

A positive pressure will be maintained in the office area relative to the outdoors by ensuring that the volume of outside air supplied to the office space is always greater than that removed from the return air plenum. In order to achieve this result, the operation of the air systems will change on a seasonal basis. The requirement for change is due primarily to the economizer operation.

Since the outside air capacity of the office area supply units is limited, relief fan RD-1 will not be operated during the heating season. Of the three units serving the office space (SF-2, 3 and 5), only SF-2 has a heating capability, therefore, SF-2 will provide the majority of the fresh air to the office space. SF-3 and SF-5 will recirculate air from the return plenum, while providing a minimal amount of fresh air as controlled through the discharge air controller. Supply air from unit SF-4, which primarily serves the north storage/workshop areas and provides make-up air to the garage (similar to SF-1), is not returned to the main return plenum. As a result, SF-4 acts as a relief fan for the office space. The system must be balanced to ensure the volume of outside air provided by units SF-2, 3 and 5 exceeds that taken from the return plenum by SF-4.

During economizer operation, additional relief capacity will be required to ensure that office space is not over-pressurized. The flow of relief air will be regulated through modulation of the relief fan exhaust damper. Damper position will be set to maintain a minimum pressure differential between the garage and the office space (with the office positive to garage). When the mixing air dampers for all units connected to the return plenum move to 100% outside air, relief fan RD-1 will be operated in exhaust mode. Fan RD-1 will be re-balanced to ensure that the exhaust rate from the return plenum does not exceed the outside air flow to the offices when RD-1 is in operation. The minimum differential pressure set-point, which must be maintained under all operating conditions, will be in the order of 75 Pa (0.25 in. w.g.). This will have to be field verified.

AIR HANDLING SYSTEM OPERATIONS OUTLINE Cont'd	DATE CHECKED	COMMENTS
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With respect to the operation of the garage ventilation system, limitations associated with the existing system configuration dictate that all air systems, including the office supply systems, must operate at all times (i.e. if one part of the facility is to be occupied, all systems must be operated). Although there are number of systems which appear to serve discrete areas of the facility, there is a strong interdependence between most units. For example, since unit SF-4 transfers air from the main return plenum to provide make-up air to the garage, SF-2, 3, 4 and 5 must be operated when the garage is in operation to ensure the office area pressurization is maintained. The garage make-up and exhaust systems are to be balanced to operate under a slight negative pressure relative to the outdoor air under normal operating conditions. Since the office area is to be maintained at a positive pressure relative to the outdoors, maintaining the office positive to the garage should be simplified.

The intermittent operation of vehicle engine exhaust systems will tend to make the garage more negative, however, the impact of these systems will be minor since the air volumes are relatively small. The improved heating at the overhead doors should reduce the impact of infiltration at these areas. The pressurization provided by units SF-1 and SF-4 along the north and south perimeter storage/workshop areas will continue to limit infiltration in these areas.

With regard to VAV box operation, the original design calls for some areas of the office to be supplied with relatively high air volumes. The repair of the VAV boxes may initiate some complaints of excessive air flow and drafts. Prior to taking action to reduce air flow, it is important to consider the effect of reduced flows on the air handling unit. Units SF-2 and SF-4 will be operating above 50% outside air in order to ensure office space pressurization is maintained. If the flow from these units is reduced, the percentage of outside air required to meet the pressurization set-point will increase, making the coil more susceptible to freezing. With this in mind, it would be preferable to reduce air flow to a space by increasing the bypass rate at the VAV box rather than throttling the air flow to the box.

WET PIPE FIRE SUPPRESSION SPRINKLERS FORM

PROJECT:
FILE NO:

PROJECT:	DATE:
FILE NO.:	
GENERAL INFO:	
Manufacturer:	Location:
Model Number:	Spec. Reference:
Serial Number:	Water Supply:

PRE START-UP VERIFICATION:	YES	NO	N/A		YES	NO	N/A
Proper Identification Signs:				Caps Provided:			
Connections in Good Condition:				Water Supply Valves Open:			
Access to Connections free from Obstructions:				Water Supply Valves Locked or Sealed:			
Swivels Free:				Water Supply Valves Supervised:			
Gaskets in Place:				Alarm Valves Tested:			
Cold Weather Valves in Correct Position: If Closed, are they Drained:				Anti-Freeze Systems Tested:			

PERFORMANCE DATA:	Specified	Actual	Remarks
System Pressure (kPa)			
Static Pressure (kPa)			

REMARKS/COMMENTS

ACKNOWLEDGED:	DATE:
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

DOMESTIC HOT WATER HEATER FORM

PROJECT:	DATE:
FILE NO:	

A. STARTUP & VERIFICATION	Specifications	Site Equipment Data Verification	Systems Verified by Commissioning Agent
Reference			
Service:			
Location:			
Manufacturer:			
Model:			
Capacity (litres):			
Recovery Rate (1/hr):			
Input (kW):			
Isolation Valves:			
Pressure Relief Valve:			
Operation Confirmed:			
Temperature Setting:			

- B. FUNCTIONAL PERFORMANCE TEST PROCEDURE**
- 1) Conduct testing on domestic water system to verify response time of hot water at most remote fixtures noted on each floor.
 - 2) Schedule test at a time when DHW is under normal operation and had not been used on the floor within eight (8) hours prior.
 - 3) Document results below.

C. TEST DATA

LOCATION	TEMP @ SOURCE	TEMP 2 DEVICE	RECORD TIME ELAPSED

REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

SPLIT A/C UNIT FORM

PROJECT:	DATE CHECKED	COMMENTS
FILE NO:		

MECHANICAL SYSTEMS VERIFICATION FORMS		
Split A/C Unit Location :		
A.	A/C UNIT	
	1) Filters in place	
	2) Equipment lubricated	
	3) Rotation verified with direction arrow at fan	
B.	FAN PERFORMANCE Information to be obtained from static forms and in conjunction with balancing contractor	
	1) Air delivery	
	2) Fan speed	
	3) Motor speed	
	4) Motor Amperage	
	5) Noise generated (see sound test report if specified) Attach report to this form	
	6) Vibration isolation (see vibration test report if specified) Attach report to this Form	
C.	FAN CONTROLS	
	1) Thermostat operation (if applicable)	
	2) Coordinate unit control with EMCS	
D.	DX COOLING	
	Prior to startup:	
	1) Unit is complete and properly installed	
	2) Electrical is complete and properly terminated	
	3) Refrigerant lines do not rub on anything	
	4) Rotate fans, check belts and pulleys	
	5) Evaporator condensate drain trapped and drain pan level	
	6) Manufacturer's start-up sheets, equipment and service literature provided	
E.	COMPRESSOR STARTUP	

SPLIT A/C UNIT FORM Cont'd	DATE CHECKED	COMMENTS
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	1) Compressors start and cycle on demand from thermostat		
	2) Proper valve, sight glass and sensor location		
	3) Safety controls operate correctly		
F.	COOLING OPERATION		
	1) Refrigerant charge according to nameplate		
G.	BLOWER OPERATION AND ADJUSTMENTS		
	1) With subbase fan switch ON blowers operate continuously		
	2) With fan switch in AUTO blowers cycle on demand		
	3) Sufficient air flow (L/S)		

NOTE: If applicable, attach non-conformance report (Admin4-034) to this form.

REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

PACKAGED DX COOLING SYSTEMS –FORM

PROJECT:
FILE NO:

A.	GENERAL INFORMATION:			
	(1) Location:	(4) Serial No.:		
	(2) Model No.:	(5) Specification Reference:		
	(3) Manufacturer			
B.	BEFORE STARTUP	YES	NO	N/A
	1) Verify that the unit is completely and properly installed in accordance with installation instructions with ductwork connected. Verify that all construction debris is removed, and that the filters are clean.			
	2) Verify that all electrical work is complete and properly terminated. Verify that all electrical connections in the unit control panel and compressor terminal box are tight, and that the proper voltage is connected			
	3) Verify that gas piping is complete and leak tight. Verify that the shutoff Has been installed from the gas lines.			
	4) Check to ensure that refrigerent lines do not rub against the cabinet or against other refrigerent lines.			
	5) Manually rotate all fans and verify that they rotate freely. Verify that the belts are tight and the sheaves are aligned.			
	6) Verify that all set screws and fasteners on the fan assemblies are still tight. Do this by reading and following the instructions in "Setscrews" which is in the "Maintenance" section of this manual.			
	7) Verify that the evaporator condensate drain is trapped, and that the drain pan is level.			
	8) If unit is curb mounted, verify that the curb is properly flashed to prevent water leakage.			
	9) Before attempting to operate the unit, review the control layout description to become familiar with the control locations. Review the equipment and service literature, the sequences of operation, and the wiring diagrams to become familiar with the functions and purposes of the controls and devices. Determine which optional controls are included with the unit.			
	10) Provide Manufacturer's start-up sheets.			
C.	COOLING STARTUP	YES	NO	N/A

PACKAGED DX COOLING SYSTEMS-ROOFTOP UNIT FORM Cont'd

	1) Set fan switch to AUTO or ON and move system selection switch to cool. Adjust thermostat to a setting below room temperature to bring on both compressors. Compressors will start and cycle on demand from thermostat.			
D.	BLOWER OPERATION AND ADJUSTMENTS			
	1) Blower operation is manually set at the thermostat subbase fan switch. With fan switch in ON position, blowers will operate continuously.			
	2) With fan switch in AUTO position, the blowers will cycle with demand. Blowers and entire unit will be off when system switch is in OFF position.			
E.	UNIT CFM			
	1) CFM measurement (L/S)			
F.	COOLING OPERATION AND ADJUSTMENTS			
	CHARGING:			
	1) If system is completely void of refrigerent, the recommended and most accurate method of charging is to weigh the refrigerent into the unit according to the amount shown on the nameplate.			
	STARTUP MECHANIC:			
	STARTUP COMPANY:			
G.	NON CONFORMANCE DESCRIPTIONS:			
REMARKS/COMMENTS:				
ACKNOWLEDGED:		DATE		
Mechanical Contractor:		Date:		
General Contractor / Consultant:		Date:		
Departmental Representative:		Date:		

AIR HANDLING UNIT FUNCTIONAL PERFORMANCE TEST

PROJECT:
FILE NO:

UNIT IDENTIFICATION:	DWG. NO.:
<p>PERSONNEL and EQUIPMENT Required to be present during Test Period: Commissioning Agent, Mechanical Contractor (with 2-way radios or cellular phones), and when required 1) TAB Agent with assorted instruments and TAB report, 2) Controls Contractor with shop drawings, 3) DND Mechanical Design Authority.</p>	
<p>A. <u>Demonstration of Discharge Air Temperature (during occupied mode):</u></p> <p>1. - Ensure that space heating is satisfied. Yes No N/A</p> <p style="padding-left: 20px;">- Record discharge air temperature into the space. _____ °C</p> <p>2. - Simulate temperature change. Yes No N/A</p> <p style="padding-left: 20px;">- Record increase in discharge air temperature into the space. _____ °C</p> <p>3. - Simulate high outdoor ambient temperature (>24°C) and a call for cooling by the space thermostat. Yes No N/A</p> <p style="padding-left: 20px;">- Observe mechanical cooling startup and record discharge air temperature into the space. _____ °C</p>	<p>Conformance (Circle)</p>
<p>B. <u>Demonstration of 100% OA (Free Cooling) Feature:</u></p> <p>- Override OAT and input constant 5°C lower than RAT. Yes No N/A</p> <p>- Open access doors at OA, EA and MA dampers. OA and EA dampers should be fully open, MA damper fully closed.</p> <p>- Restore initial setting.</p>	<p>Conformance (Circle)</p>
<p>C. <u>Test of DDC controls</u></p> <p>1. Check operation of the time clock and observe startup of the supply fan. Yes No N/A</p> <p>2. Simulate the unoccupied mode using the time clock, simulate temperature change, and observe startup of the air handling unit. Yes No N/A</p> <p>3. Check interlock with exhaust fan. Activate exhaust fan system locally and observe AHU operation damper modulation (O/A fully open) and exhaust fan startup. Yes No N/A</p> <p style="padding-left: 20px;">Manually shutoff AHU and observe shutdown of the exhaust fan via air proving switch. Yes No N/A</p> <p>4. Simulate power failure to AHU and observe power restart of the AHU by the DDC system. Yes No N/A</p> <p>5. Gas Monitor: Yes No N/A</p> <p style="padding-left: 20px;">- Activate CO detector manually.</p> <p style="padding-left: 20px;">- Observe startup of AHU.</p> <p style="padding-left: 20px;">- Observe startup of exhaust fans.</p> <p style="padding-left: 20px;">- Verify alarm print out and Alarm at Main Panel.</p> <p style="padding-left: 20px;">- Restore system.</p> <p style="padding-left: 20px;">- Repeat using NO2 cartridge.</p> <p>6. Does operation correspond to sequence described in Specification? Yes No N/A</p> <p>7. System monitoring Yes No N/A</p> <p style="padding-left: 20px;">- Observe supply air temperature readings: Actual Reading at AHU supply _____ °C</p>	<p>Conformance (Circle)</p>

AIR HANDLING UNIT FUNCTIONAL PERFORMANCE TEST Cont'd

COMMENTS:

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

PIPING TESTS VERIFICATION FORM

PROJECT: FILE NO:	DATE CHECKED	COMMENTS
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A.	Testing Procedures:		
	1. Give 24 hours written notice of date for tests.		
	2. Insulate or conceal work only after testing and approval by Consultant.		
	3. Conduct tests in presence of departmental representative.		
	4. Bear costs, including re-testing and making good.		
B.	Piping:		
	1. General: Maintain test pressure without loss for 4 hours, unless otherwise specified.		
	2. Hydraulically test steam and hydronic piping systems at 1-1/2 times system operating pressure or minimum 860 kPa, whichever is greater.		
	3. Test drainage, waste and vent piping to National Building Code and authorities having jurisdiction.		
	4. Test domestic hot, cold and recirculation water piping at 1-1/2 times system operating pressure or minimum 860 kPa, whichever is greater.		
	5. Test sprinkler systems in accordance with authorities having jurisdiction and as specified in NFPA-13.		
	6. Equipment: Test as specified in relevant sections.		
	7. Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.		

REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

GENERAL REQUIREMENTS – MECHANICAL SYSTEMS VERIFICATION FORM

PROJECT:	DATE	
FILE NO.:	CHECKED	COMMENTS

A.	Manufacturers' Certificates Submitted as per Contract Documents		
	1. Pumps		
	2. Energy Management and Control Systems		
	3. A / C Systems (built-up)		
	4. Heating and Ventilation Systems (built-up)		
	5. Pressure Tanks (Air Compressor, Fuel storage, Expansion Tanks)		
	6. Domestic Hot Water Tank		
	7. Storage Tanks (domestic hot water)		
B.	Finishes Repaired and Touched Up.		
C.	Identification		
	1. Plumbing Equipment		
	2. Plumbing Piping		
	3. Heating Equipment		
	4. Heating Piping		
	5. Cooling Equipment		
	6. Cooling Piping		
	7. Ventilation Equipment		
	8. Duct Work Identified as per Contract Documents		
	9. Sprinkler Equipment (special identification)		
	10. Sprinkler Piping (identified) (painted)		
	11. Stand Pipe System Piping		
	12. Specialty Equipment		
	13. Specialty Piping		
D.	Systems Balancing Completed and all Reports Received		
	1. Water		
	2. Air		
	3. Plumbing Fixtures		
	4. Plumbing Recirculation Systems		
E.	Cleaning		
	1. Plumbing Equipment		

GENERAL REQUIREMENTS – MECHANICAL SYSTEMS VERIFICATION REPORT Cont'd	DATE CHECKED	COMMENTS
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	2. Heating Equipment		
	3. Ventilation Equipment		
	4. Sprinkler Equipment		
	5. Stand Pipe Equipment		
	Note: Attach Non Conformance Report to this form (Admin4-034)		

REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Electrical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

FIRE PROTECTION VERIFICATION FORM

PROJECT:	DATE CHECKED	COMMENTS
FILE NO:		

A.	System pressure set and stable.		
B.	Flush each zone at flush connection.		
C.	Pressure Alarm switches work.		
D.	Valve Supervisory switches work.		
E.	Flow switches operate.		
F.	Fire Hose operation demonstrated.		
G.	Excess pressure pump operates.		
H.	Reset system pressure.		

REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

**PLUMBING SYSTEMS
MECHANICAL SYSTEMS VERIFICATION FORM**

PROJECT: FILE NO:	DATE CHECKED	COMMENTS
A. Pressure Tests, Waste and Vent		
B. Pressure Tests, Water Piping:		
1) Hot Water		
2) Cold Water		
3) Recirculation		
C. Water Systems Cleaned and Flushed		
D. Verify the Operation of:		
1) Faucet Operation		
2) Flush Valve Operation		
3) Hose Bibb Operation		
E. Trap Seal Primer Operation		
F. Drinking Fountain Operation		
G. Domestic Hot Water Heater Operation		
H. Domestic Water Pumps:		
1) Recirculation Pumps		
2) Booster Pumps		
I. Accessories:		
1) Cleanouts		

PLUMBING SYSTEMS MECHANICAL SYSTEMS VERIFICATION FORM Cont'd	DATE CHECKED	COMMENTS
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	2) Floor drains		
	3) Access doors		
	4) Isolation Valves		
	5) Drain Valve Location and Type as per Contract Documents		
J.	Sump Pump Operation:		

REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

PUMPS MECHANICAL SYSTEMS VERIFICATION FORM

PROJECT: FILE NO:	DATE CHECKED	COMMENTS
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A.	Correct rotation		
B.	Flow rate (verify with balancing contractor) review and plot each pump, refer to static forms)		
C.	Developed head (verify with balancing contractor)		
D.	Amperage draw (refer to static forms) electrical		
E.	Pump speed (verify with balancing contractor)		
F.	Pump curve obtained (review with balancing contractor)		
G.	Plot all operating points on pump curves with the balancing contractor, copy to be attached to this form (each pump)		

REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

AIR DISTRIBUTION MECHANICAL SYSTEMS VERIFICATION FORM

PROJECT:	DATE	COMMENTS
FILE NO:	CHECKED	

A.	Ductwork leakage tests completed		
B.	Site Visit reports submitted		
C.	Balancing Dampers installed as required		
D.	Fire dampers installed and verified		
E.	Access doors installed as specified		
F.	Instrument test ports installed		
	1. Balancing		
	2. Temperature controls		
G.	Security screens		
H.	Acoustic linings		
I.	Waterproof duct installed as specified		
J.	Louvers and screens in place and secure		

REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

AIR HANDLING EQUIPMENT VERIFICATION FORM

PROJECT: FILE NO:	DATE CHECKED	COMMENTS
A. Air Handling Equipment		
<ol style="list-style-type: none"> 1. Filters in place 2. Equipment lubricated 3. Rotation verified with direction arrow at fan 4. Belt tension and pulley alignment checked 		
B. Fan Performance		
Information to be obtained from static forms and in conjunction with balancing contractor.		
<ol style="list-style-type: none"> 1. Air delivery 2. Static pressure at unit (different locations) 3. Fan speed 4. Motor speed 5. Motor Amperage 6. Fan curves obtained (attach plot copy to this form) 7. Plot operating points on fan curve form (supplied by balancing contractor) 8. Noise generated (see sound test report if specified) Attach report to this form 9. Vibration isolation (see vibration test report if specified) Attach report to this Form 		
C. Fan Controls		
<ol style="list-style-type: none"> 1. Thermostat operation (if applicable) 2. Fan interlocks (refer to sequence of operation) 3. Co-ordinate unit control with EMCS (if rooftop also with manufacturer) 		
D. Coil Elements		
<ol style="list-style-type: none"> 1. Coils vacuumed and dust free 2. Coil elements combed (if fins bent at tubes) 		
E. Heating Coil Performance		
<ol style="list-style-type: none"> 1. Air entering temperature (review with balancing contractor) 2. Air leaving temperature (as above) 3. Air flow rate across coil (review with balancing contractor) 4. Pressure drop across coil (review as above) 5. Accommodation for cooling coil box (refer to specifications) 6. Space allowed for coil removal (each coil) 		
F. Steam Humidifiers Performance		
<ol style="list-style-type: none"> 1. Power draw (see electrical static forms) 2. Flush operation 		

DUCT TESTS VERIFICATION FORM

PROJECT: FILE NO:	DATE CHECKED	COMMENTS
A. DUCT TESTS		
1. Give 24 hrs written notice of date for tests.		
2. Insulate or conceal work only after testing and approval by Consultant.		
3. Conduct tests in presence of departmental representative.		
4. Bear costs including re-testing and making good.		
B. LEAKAGE TESTS		
1. In accordance with SMACNA HVAC Duct Leakage Test Manual.		
2. Do leakage tests in sections.		
3. Make trial leakage tests as instructed to demonstrate the workmanship.		
4. Install no additional ductwork until trial test has been passed.		
5. Test section minimum of 30 Meters long with not less than 3 branch takeoffs and 290° elbows.		
6. Complete test <u>before</u> duct installation or concealment.		
C. WATER TIGHT DUCT		
1. Fresh Air Intakes		
2. Minimum of 3000mm (10') in all directions from humidifier distribution tube. No (longitudinal) seams at bottom of horizontal duct, weld joints at bottom and side sheets.		
NOTE: Attach the official test results signed by testing agency when received from the Balancing Contractor or Agency.		
NOTE: Attach Non Conformance Report to this form		
REMARKS/COMMENTS:		
ACKNOWLEDGED:	DATE	
Mechanical Contractor:	Date:	
General Contractor / Consultant:	Date:	
Departmental Representative:	Date:	

DEFERRED OR SEASONAL COMMISSIONING REQUIREMENTS

PROJECT: FILE NO:	DATE CHECKED	COMMENTS
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	MECHANICAL SYSTEMS		
A.	The performance of the cooling system components is to be verified on a design day during mid-summer.		
B.	The performance of the heating system components is to be verified as a design day during winter.		
C.	Performance of humidification equipment is to be verified during winter months.		

REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

SOUND & VIBRATION LEVELS

PROJECT: FILE NO:

A. Criteria for Acceptable HVAC Noise Levels in Unoccupied Rooms

Occupancy	Preferred	Alternate*
Private Residence	RC 25-30 (N)	NC 25-30
Apartments	RC 30-35 (N)	NC 30-35
Hotels/Motels:		
Individual Rooms or Suites	RC 30-35 (N)	NC 30-35
Meeting/Banquet Rooms	RC 30-35 (N)	NC 30-35
Halls, Corridors, Lobbies	RC 30-40 (N)	NC 30-40
Service/Support Areas	RC 40-45 (N)	NC 40-45
Offices:		
Executive	RC 25-30 (N)	NC 25-30
Conference Rooms	RC 25-30 (N)	NC 25-30
Private	RC 30-35 (N)	NC 30-35
Open - Plan Areas	RC 35-40 (N)	NC 35-40
Business Machines/Computers	RC 40-45 (N)	NC 40-45
Public Circulation	RC 40-45 (N)	NC 40-45
Hospitals and Clinics:		
Private Rooms	RC 25-30 (N)	NC 25-30
Wards	RC 30-35 (N)	NC 30-35
Operating Rooms	RC 25-30 (N)	NC 25-30
Laboratories	RC 30-35 (N)	RC 30-35
Corridors	RC 30-35 (N)	NC 30-35
Public Areas	RC 35-40 (N)	NC 35-40
Churches	RC 30-35 (N)	NC 30-35
Schools		
Lecture and Classrooms	RC 30-35 (N)	NC 30-35
Open-plan Classrooms	RC 35-40 (N)	NC 35-40
Libraries	RC 35-40 (N)	NC 35-40
Courtrooms	RC 35-40 (N)	NC 35-40
Legitimate Theatres	RC 20-25 (N)	NC 20-25
Movie Theatres	RC 30-35 (N)	NC 30-35
Restaurants	RC 40-45 (N)	NC 40-45
Concert and Recital Halls	RC 15-20 (N)	NC 15-20
Recording Studios	RC 15-20 (N)	NC 15-20
TV Studios	RC 20-25 (N)	NC 20-25

*The NC curve noise-rating procedure may be used where rumbly, hissy or tonal characteristics in the background sound can be tolerated, if it is not too loud.

DOMESTIC WATER SYSTEM VERIFICATION of OPERATION FORM

PROJECT:	DATE	
FILE NO:	CHECKED	COMMENTS

A.	Main supply valve is open		
B.	Pressure regulators & set to correct operating pressure (550 Kpa max.)		
C.	Back-flow preventers, vacuum breakers		
D.	Pumps are running and appropriate valves are open.		
	1. Booster		
	2. Recirc.		
E.	Valves are open to Pressure indicators to show discharge pressure of the pump.		
F.	Operate each fixture to ensure there is no air in the system (hot & cold)		
G.	Valve is open to Expansion tank.		
H.	Flushing Disinfection and Water Testing is completed. (Form MF4-051)		
I.	Strainers have been cleaned		
J.	D.H.W. heater is on		
K.	Valves open to D.H.W. storage tanks and water temperature is at setpoint.		
L.	Water hammer arrestors:		
	1. are accessible		
	2. isolating valves are open		
M.	Trap seal primers:		
	1. Operate fixture supplying water		
	2. Observe water running into trap		
	3. Adjust flow rate to suit site conditions		

DOMESTIC WATER SYSTEM VERIFICATION of OPERATION FORM Cont'd	DATE CHECKED	COMMENTS
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N.	Balance D.H.W. system (balancing report)		
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O.	Operate all hot water valves and note length of time to get hot water		
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REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

SEASONAL COMMISSIONING (SAMPLE SPEC.)

PROJECT:
FILE NO:

A.	SEASONAL COMMISSIONING		
	1. After the Mechanical and Electrical systems have been accepted by the Departmental Representative, the Seasonal Commissioning Plan shall be initiated.		
	2. The CA and Consultants shall coordinate the Seasonal Commissioning Plan with the departmental representative.		
	3. Seasonal Commissioning shall take place within 12 months of Building Acceptance and in a period of time in which the building systems can be tested to demonstrate their performance under summer and winter outdoor design conditions.		
	4. The CA shall arrange with the Consultant to prepare a Seasonal Commissioning Schedule.		
	5. The overall results shall be submitted in report form to the Design Manager summarizing this activity and an overview of the overall performance of both Mechanical and Electrical systems.		
	6. Should the CA/Consultant uncover problems during the seasonal tests, the report should highlight these problems and submit suggested corrective actions.		
	7. Seasonal Commissioning documentation including Verification Forms, Test Forms, System Functional Performance Tests, are compiled in a section at the end of this plan.		

REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

DX COOLING EQUIPMENT VERIFICATION FORM

PROJECT:	DATE CHECKED	COMMENTS
FILE NO:		

A.	DX Cooling Equipment Location: Prior to start-up		
	1. Unit is complete and properly installed		
	2. Electrical is complete and properly terminated		
	3. Refrigerant lines do not rub on anything		
	4. Rotate fans, check belts and pulleys		
	5. Evaporator condensate drain trapped and drain pan level		
	6. Manufacturer's start-up sheets, equipment and service literature provided		
B.	Compressor Start-up		
	1. Compressors start and cycle on demand from thermostat		
	2. Proper valve, sight glass and sensor location		
	3. Safety controls operate correctly		
C.	Cooling Operation		
	1. Refrigerant charge according to nameplate		
D.	Blower Operation and Adjustments		
	1. With sub-base fan switch ON blowers operate continuously		
	2. With fan switch in AUTO blowers cycle on demand		
	3. Sufficient air flow (L/S)		
	Note: <i>If applicable, attach Non-Conformance Report</i>		

REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

FAN COIL UNIT VERIFICATION FORM

PROJECT: FILE NO:	DATE CHECKED	COMMENTS
A. Fan Coil Unit Location : Fan Coil Unit		
.1 Filters in place		
.2 Equipment lubricated		
.3 Rotation verified with direction arrow at fan		
B. Fan Performance		
Information to be obtained from static forms and in conjunction with balancing contractor.		
1. Air delivery		
2. Fan speed		
3. Motor speed		
4. Motor Amperage		
5. Noise generated (see sound test report if specified) Attach report to this form		
6. Vibration isolation (see vibration test report if specified) Attach report to this form		
C. Fan Controls:		
1. Thermostat operation (if applicable)		
2. Coordinate unit control with EMCS		
D. Coil Elements		
1. Coils vacuumed and dust free		
2. Coil elements combed (if fins bent at tubes)		
E. Heating Coil Performance		
1. Air leaving temperature		
2. Air flow rate across coil (review with balancing contractor)		
3. SCR is functioning		
4. Space allowed for coil removal (each coil)		
Note: <i>If applicable, attach Non-Conformance Report</i>		

FAN COIL UNIT VERIFICATION FORM Cont'd	DATE CHECKED	COMMENTS
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REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

CIRCULATION PUMP VERIFICATION FORM

PROJECT:
FILE NO:

GENERAL INFO:			
Manufacturer:		Location:	
Model Number:		Spec. Reference:	
Serial Number:			
MOTOR DATA:			
Manufacturer:		Panel No:	
Model:		Power (V/Ph/Hz):	
RPM:		Thermal Protection:	
HP:		Fuse Rating:	

Pre Start-up Verification:	YES	NO	N/A		YES	NO	N/A
Piping Installation Complete:				Unit Cleaned:			
Pressure Gauges Installed:				Power Wiring Complete:			
Volute Venting Pet Cock Installed:				Abnormal Vibrations:			
Lubrication Complete:				Direction of Rotation Correct:			
Strainers Installed and Cecked:				Leakage in Packing/Glands:			

Performance Data:	Specified	Actual	Remarks
Flow Rate (L/s)			
Pressure (kPa)			
Voltage: A-B			
A-C			
B-C			
Amperage: A-B			
A-C			
B-C			

REMARKS/COMMENTS:	
ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

WATER PUMP VERIFICATION FORM

PROJECT:
FILE NO:

GENERAL INFO:			
Manufacturer:		Location:	
Model Number:		Spec. Reference:	
Serial Number:			
MOTOR DATA:			
Manufacturer:		Panel No:	
Model:		Power (V/Ph/Hz):	
RPM:		Thermal Protection:	
HP:		Fuse Rating:	

Pre Start-up Verification:	YES	NO	N/A		YES	NO	N/A
Piping Installation Complete:				Unit Cleaned:			
Pressure Gauges Installed:				Power Wiring Complete:			
Volute Venting Pet Cock Installed:				Abnormal Vibrations:			
Lubrication Complete:				Direction of Rotation Correct:			
Strainers Installed and Cecked:				Leakage in Packing/Glands:			

Performance Data:	Specified	Actual	Remarks
Flow Rate (L/s)			
Pressure (kPa)			
Voltage: A-B			
A-C			
B-C			
Amperage: A-B			
A-C			
B-C			

REMARKS/COMMENTS:	
ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

EXHAUST FANS VERIFICATION FORM

PROJECT:
FILE NO:

GENERAL INFO:		Location:	
Manufacturer:		Spec. Reference:	
Model Number:		Fan Type:	
Serial Number:		Drive Type:	
MOTOR DATA:			
Manufacturer:		Panel No.:	
Model:		Power (V/Ph/Hz):	
H.P.:		Thermal Protection:	
Type:		Fuse Rating:	

Start-up Verification:	YES	NO	N/A		YES	NO	N/A
Flexible Connections (Durodyne) Installed:				Unit Cleaned:			
Vibration Isolation Specified:				Power Wiring Complete:			
Vibration Isolation Installed & Checked:				Direction of Rotation Correct:			
Ductwork Installation Complete:				Abnormal Vibrations:			
Alignment Complete (if belt drive):				Backdraft Damper Specified:			
Belt Drive Tension Adjusted (if belt drive):				Backdraft Damper Installed:			

Ventilation Data		Design	Measured	Remarks
Flow (L/s)				
Outlet Velocity (m/s)				
Ext. Static Pres. (Pa.)				
Fan RPM				
Voltage	A-B			
	A-C			
	B-C			
Amperage	A-B			
	A-C			
	B-C			

REMARKS/COMMENTS:	
ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

AIR HANDLING UNIT EQUIPMENT INSPECTION AND START-UP REPORT

PROJECT:	
FILE NO:	

GENERAL INFO:			
Manufacturer:		UNIT IDENTIFICATION:	
Model Number:		DWG. NO.	
Serial Number:		Location:	
Fan Type:		Type of Service:	
MOTOR DATA:			
Manufacturer:		Panel No.:	
Model:		Power (V/Ph/Hz):	
H.P.:		Thermal Protection:	
Type:		Fuse Rating:	
BURNER DATA:			
Manufacturer:		Model No:	
MOTOR DATA:			
Manufacturer:		Panel No:	
Model:		Power (V/Ph/Hz):	
H.P.:		Thermal Protection:	

Start-up Verification:	YES	NO	N/A		YES	NO	N/A
Flexible Connections (Durodyne) Installed:				Unit Cleaned:			
Vibration Isolation Installed & Checked:				Power Wiring Complete:			
Piping & Ductwork Installation Complete:				Belt Drive Tension Adjusted:			
Alignment Complete:				Abnormal Vibrations:			
Filters Checked and/or Changed:				Direction of Rotation Correct:			
Lubrication Complete:				Air Mixing Dampers:			
				Safety Devices Functioning			
Ventilation Data	Design			Measured	Remarks		
Flow (L/s)							

AIR HANDLING UNIT ANCILLARY DEVICES VERIFICATION REPORT

PROJECT:
FILE NO:

UNIT IDENTIFICATION:						
ITEM			ACCEPTANCE			REMARKS
			YES	NO	N/A	
15081	Insulation	Supply				
		Return				
15811	Ductwork					
15813	Flexible Connections					
15820	Accessories	Access Doors				
		Test Ports				
15822	Operating Dampers - stroke open to closed					
15823	Fire and Smoke Dampers					
15851	Louvres, Intakes, Vents, Birdscreen					
15950	TAB (report submitted)					

- Acceptable
 Not Acceptable
 Not Applicable

REMARKS/COMMENTS:

ACKNOWLEDGED:	DATE
Mechanical Contractor:	Date:
General Contractor / Consultant:	Date:
Departmental Representative:	Date:

APPENDIX III - GEOTECHNICAL REPORT

DSRA ARCHITECTURE

PROPOSED RCMP DETACHMENT INGONISH, NOVA SCOTIA

GEOTECHNICAL INVESTIGATION REPORT

FINAL

PROJECT NO.: 1389-001
DATE: June 2, 2014

DISTRIBUTION:
RECIPIENT: 2 copies
BGC: 2 copies
OTHER: 1 copy



BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Suite 630 - 1718 Argyle Street
Halifax, NS Canada B3J 3N6
Telephone (902) 474-5925
Fax (902) 474-5929

June 2, 2014
Project No.: 1389-001

Jeffrey Theriault P.Eng

SNC Lavalin c/o DSRA Architecture
Park Lane Terraces, 5657 Spring Garden Road, Suite 200
Halifax, Nova Scotia, B3J 3R4

Dear Mr. Theriault,

Re: Proposed RCMP Detachment: Geotechnical Engineering Report - Ingonish, NS

BGC Engineering Inc. is pleased to provide DSRA Architecture with electronic and two (2) hard copies of the above referenced Final report dated June 2, 2014.

Should you have any questions or comments, please do not hesitate to contact me at 902-474-5925.

Yours sincerely,

BGC ENGINEERING INC.
per:

ISSUED AS DIGITAL DOCUMENT.
SIGNED HARDCOPY ON FILE WITH
BGC ENGINEERING INC.

Anthony Urquhart M.Eng., P.Eng.
Project Manager

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LIMITATIONS

BGC Engineering Inc. (BGC) prepared this document for the account of DSRA Architecture. The material in it reflects the judgment of BGC staff in light of the information available to BGC at the time of document preparation. Any use which a third party makes of this document or any reliance on decisions to be based on it is the responsibility of such third parties. BGC accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this document.

As a mutual protection to our client, the public, and ourselves, all documents and drawings are submitted for the confidential information of our client for a specific project. Authorization for any use and/or publication of this document or any data, statements, conclusions or abstracts from or regarding our documents and drawings, through any form of print or electronic media, including without limitation, posting or reproduction of same on any website, is reserved pending BGC's written approval. If this document is issued in an electronic format, an original paper copy is on file at BGC and that copy is the primary reference with precedence over any electronic copy of the document, or any extracts from our documents published by others.

1.0 INTRODUCTION

BGC Engineering Inc. (BGC) was retained by DSRA Architecture (DSRA) with the assistance of SNC Lavalin (SNC) to conduct a geotechnical investigation to support design and construction of an RCMP detachment in Ingonish, NS. The geotechnical investigation was carried out in general accordance with our proposal letter to Jeffrey Theriault P.Eng of SNC, and dated April 24, 2014. Authorization to proceed with the investigation was provided by Mr. Theriault in an email dated April 28, 2014.

This report presents all findings of the work undertaken, and provides recommendations for design and construction.

1.1. Proposed Development

The proposed development is located along the west side of the Cabot Trail near Ingonish, Victoria County, Nova Scotia. The property is identified as Lot 14-2, PID# 85049187 and is approximately 1.6 hectares in size. The property is adjacent to existing residential properties to the north and south and Dino's Campground is found across from the site on the east side of the Cabot Trail. Undeveloped land lies to the west of the property.

Based on information provided by SNC, it is understood that the facility will be designed as single story, at-grade structures, with no basements. Two (2) primary structures are proposed a cold storage building found to the west side of the site, and a main building comprised of the detachment primary wing, and patrol pavilion facing east toward the Cabot Trail. The site development will also include asphalt driveways, parking areas, an on-site septic system, and landscaping. The general configuration of the facilities is shown on Drawing 1, attached. In addition, it is understood that future expansion may occur, however no details have been provided to BGC at this time.

The two (2) proposed structures include building footprints of approximately 90 m² for the cold storage building, and 650 m² for two (2) wings of the main building. It is understood that the finished floor elevation (FFE) is proposed at approximately 50.75 m (Geodetic Datum).

1.2. Scope of Work

The purpose of the geotechnical investigation was to assess the subsurface conditions at the proposed site and to provide geotechnical engineering recommendations for site preparation, building foundation design, and pavement design of the proposed facilities. The scope of the geotechnical investigation included the following components:

1. Site reconnaissance to layout and clear access for the test pits, and to inspect the ground surface of the site for potential evidence of karst features.
2. Completion of a subsurface investigation consisting of seven (7) test pits.
3. Preparation of a geotechnical report including a test pit site plan, detailed test pit logs, and associated geotechnical recommendations required for design and construction.

2.0 SITE INVESTIGATION PROCEDURES

2.1. Site Reconnaissance

A site reconnaissance was conducted by BGC on May 01, 2014 to visually assess the site, to layout test pit locations, and establish cut lines to access the locations. Test pit coordinates were provided by SNC and modified by BGC to minimize disturbance within the building footprints. Test pits were located in field by BGC using a handheld GPS.

2.2. Test Pits

The field investigation consisted of seven (7) exploratory test pits (TP-BGC14-01 to TP-BGC14-07) completed on May 07, 2014, using a track mounted hydraulic excavator. The test pits were excavated to depths ranging between 2.8 m and 4.3 m. Subsurface conditions encountered in the test pits were recorded in the field by BGC. Soil samples were obtained for geotechnical laboratory testing and any groundwater seepage observed was noted in the field as the excavation of the test pit progressed. All test pits were backfilled using the excavated material and tamped in place with the excavator bucket. The test pit locations are shown on Drawing 1, attached.

The subsurface conditions and soil types encountered are shown on the test pit logs presented in Appendix A. Soil types were classified in general accordance with the Unified Soil Classification System (USCS) and the relative density estimated by excavator performance. Select photographs of each test pit excavation are also attached.

2.3. Laboratory Testing

Representative soil samples were collected from each geologic stratum, delivered to the soils laboratory, and tested for moisture content, and grain size distribution. In addition, one (1) sample was analysed for soluble manganese metal content. The laboratory report results are presented in Appendix C.

3.0 SITE CONDITONS

3.1. Site Description and Topography

The project site is currently heavily vegetated with trees, and has no existing driveway access. At the time of the investigation the site was snow covered.

Based on the topographic information provided from SNC, the existing ground surface elevation at the proposed cold storage building is near elevation 52 m, and ranges from approximately elevation 51 m to 49.5 m at the proposed main building. The general topographic profile of the property is sloping in an easterly direction toward the Cabot Trail at approximately 4.5%.

3.2. Geology

Available surficial geology mapping by Stea et al. (1992) shows that soil conditions in the Ingonish area are typically a silty glacial till derived from the local sedimentary bedrock. In addition, mapping indicates that glaciofluvial deposits comprised of kames and eskers are also present in some areas.

The bedrock in the Ingonish area is described by Lin (1992), and Keppie (2000), as undifferentiated Carboniferous sedimentary rocks belonging to the Windsor Group and is shown on Drawing 2 attached. The Windsor Group bedrock in this area can be comprised of unmetamorphosed, limestone, sandstone, and conglomerate. Granite and granodiorite igneous bedrock is shown to the east and west of the site, respectively.

Four (4) water well logs were available near the subject site from the Nova Scotia Department of Environment database. Well logs indicate glacial tills soils at surface ranging from 5 to 11 m thick and bedrock encountered was typically granite, with limestone and quartzite encountered in two (2) of the wells.

Karst activity in the form of solution cavities are prevalent in areas underlain by limestone, gypsum, anhydrite, etc. These landforms can include features such as sinkholes and caverns which can potentially undermine structural foundations. BGC is aware of visible karst susceptible bedrock from available background mapping, water well logs and visual observations along the coast line near the Ingonish area.

3.3. Seismic Hazard

Site specific seismic hazard information was obtained from Natural Resources Canada at www.EarthquakesCanada.ca and can be found attached in Appendix B. The National Building Code of Canada (NBCC 2010) Peak Ground Acceleration (PGA), and design ground motions, corresponding to a 2 % probability of exceedence in 50 years (0.000404 per annum) are detailed in Table 3-1 below.

Table 3-1. National Building Code of Canada Recommended Design Motions

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA (g)
0.156	0.109	0.068	0.023	0.055

1. Sa is spectral acceleration at the selected period (e.g. 0.2 seconds), in units of acceleration due to gravity, g
2. PGA Peak ground acceleration, in units of acceleration due to gravity, g.

3.4. Subsurface Conditions

In general, the soils encountered in the test pits are generally comprised of a compact glaciofluvial sand, overlying bedrock, or glaciofluvial sand, overlying compact to dense glacial till, overlying bedrock. At two (2) test pit locations (TP-BGC14-05 and -06) a soft clay material with variable thickness was encountered above the glacial till. Table 3-2 provides a summary of the elevations and the overall thickness of the geologic units logged in the test pit excavations. Test pit elevations were provided by SNC.

Properties of the major geological strata encountered are summarized below and a detailed description of the subsurface conditions are presented on the attached test pit logs included in Appendix A.

3.4.1. Topsoil

A layer of moss and topsoil approximately 50 mm in thickness was encountered at the surface in all of the test pits

3.4.2. Glaciofluvial Sand

Glaciofluvial sand was encountered in all test pits immediately below the surficial topsoil layer. The thickness of the sand varied between 1.95 m to greater than 3.2 m. The relative density of the sand was observed as loose to compact in the upper 0.5 m and compact to dense below this depth. The sand is generally described as moist, trace to some silt, trace to some gravel, and trace cobbles. Particles are subangular and subrounded. The moisture content of samples ranged from 10.8 % and 15.8% with an average of 12.8%. Grain size distribution tests show the sand ranges between 10 to 30% gravel, 58 to 79% sand, and 11 to 20% silt and clay sizes.

Table 3-2. Summary of Site Stratigraphy.

Test Pit	¹ Ground Elevation (m)	Strata Thickness				Till Elevation (m)	Bedrock Elevation (m)	² Groundwater Elevation (m)	Test Pit Depth (m)
		Topsoil (m)	Glaciofluvial Sand (m)	Clay (m)	Till (m)				
TP-BGC14-01	50.2	0.05	2.75	-	-	-	47.4	47.6	2.8
TP-BGC14-02	51.2	0.05	3.95	-	-	-	47.2		4.0
TP-BGC14-03	51.3	0.05	>3.2	-	-	-	-		3.2
TP-BGC14-04	52.6	0.05	>2.9	-	-	-	-		2.9
TP-BGC14-05	49.3	0.05	1.95	0.2	1.3	45.8	-		3.5
TP-BGC14-06	49.8	0.05	1.95	1.4	0.9	46.4	45.3	47.1	4.3
TP-BGC14-07	50.8	0.05	2.35	-	1.4	48.4	47.0		3.8

Notes:

1. Test Pit surface elevations provided by SNC Lavalin May 20, 2014.
2. Indicates groundwater seepage. Near surface spring thaw seepage noted in all test pits

3.4.3. Clay

Clay was encountered near the south side of the proposed main building at TP-BGC14-05 and -06 at a depth of 2.0 m at both locations. The thickness of the clay varied between the two (2) location ranging between 0.2 m and 1.4 m at TP-BGC14-05 and -06. The clay can be described as soft, wet, sandy clay with medium to high plasticity. One (1) sample indicated a moisture content of 67% and a gradation of 0% gravel, 39% sand and 61% silt and clay sizes. A sample of the clay was analyzed for extractable (soluble) manganese content and the results indicated a concentration of 18,000 mg/kg.

3.4.4. Glacial Till

The glacial till (till) was encountered below the glaciofluvial sand and/or clay in test pits, TP-BGC14-05, -06, and -07. The till consisted of compact to dense, silty sand, gravelly, with trace clay, some cobbles, and trace boulders. Particles shapes are predominately subrounded to subangular. The moisture content of two (2) samples ranged from 17 % and 18.5%. Grain size distribution test results from one (1) sample show the till consists of approximately 9% gravel, 45% sand and 46% silt and clay sizes.

3.4.5. Bedrock

Bedrock was encountered at four test pit locations at depths ranging between 2.8 and 4.3 m. Conglomerate bedrock was encountered near the north of the site at TP-BG14-01 and limestone bedrock was encountered at TP-BGC-14-06 and -07 to the south. The conglomerate bedrock is described as weak, light grey, coarse grained with fine and medium grained inclusions. The limestone bedrock is described as weak, grey white, fine grained with iron staining and exhibited a reaction to hydrochloric acid.

3.4.6. Groundwater

Moderate to heavy flow of near surface seepage was noted in all test pits ranging in depth from 0.3 to 0.9 m. This was primarily due to the active spring thawing occurring at the time of the investigation. In addition, deeper groundwater seepage was encountered in TP-BGC14-01 and -06, at depths of approximately 2.6 and 2.7 m respectively.

It should be noted that groundwater levels are subject to fluctuations due to precipitation events and on a seasonal basis

3.4.7. Frost Action

The soils encountered within the expected depth of frost penetration on site are considered low to moderately frost susceptible. Based on an air freezing index of approximately 500 degree-days Celsius, the maximum depth of frost penetration is estimated to be about 1.5 m.

These depths of frost penetration are based on a uniform soil type with no insulation cover. In areas covered with turf or with significant snow cover, the depth of frost penetration will be less.

4.0 GEOTECHNICAL DISCUSSION AND RECOMMENDATIONS

4.1. Site Preparation

Site preparation within the building footprint and driving areas will require clearing and grubbing of trees and stumps and removal of all topsoil.

As noted in Section 3.4 a soft clay material was encountered overlying till at a depth of 2.0 m and extending up to a depth of 3.4 m. If left in-place, the clay material is not considered suitable for satisfactory performance of spread footing foundations and concrete slabs.

Based on our discussions with SNC it is understood that shifting the building footprint to avoid this unsuitable clay material is not preferred. Therefore, it is recommended that all clay material within the existing footprint of the building be removed, and replaced with a well-graded structural fill material. Further details and discussion for foundations is provided in Section 4.5.

Site drainage should be established during the early stages of construction in order to develop and help maintain adequate site access and trafficability. It is recommended that the finished site grade should be sloped to provide positive drainage away from the building foundations and towards drainage ditches.

4.2. Potential Karst Activity

As previously discussed, the project site is underlain by Windsor Group bedrock that is susceptible to potential karst activity and development of sinkholes. Sinkholes can develop by introduction of acidic surface precipitation that comes in contact with karst susceptible bedrock. A review of available aerial photographs did not identify any existing surface expressions or suspect depressions that would indicate karst activity. In addition the site reconnaissance did not identify any sinkhole features however as noted above, the ground surface was snow covered during that time.

As noted in Section 3.0, the subsurface investigation encountered limestone bedrock to the south of the site. In addition, a soft clay material was encountered in TP-BGC14-05 and -06. The geological origin of this clay is not clear, however this material was found above the glacial till which is in direct contact with bedrock, with no apparent indication of voids. Analytical testing on the clay indicates the presence of a high soluble manganese content (18000 mg/kg) potentially associated with leaching of limestone bedrock.

Based on the exposed bedrock encountered in the test pits at the south end of the site, the potential for karst activity cannot totally be discounted even though the current investigation has not detected such an occurrence. Therefore it is recommended that continuous inspection of the ground conditions during excavations be conducted by qualified geotechnical personnel to observe for any indication of sinkholes. Should there be an indication of a potential sinkhole feature, it is recommended that further subsurface investigation be undertaken to evaluate the feature. This investigation may include a geotechnical borehole drilled at the suspect location

to determine the potential depth of the feature. The scope and extent of such an investigation would be developed at that time if necessary.

To help minimize the risk of a sinkhole developing after construction, it is strongly recommended that site grading be established to provide positive drainage both during and after construction as discussed above. Note that accurate prediction of where or when sinkholes can occur is not an exact science, and typically the only available option to remove the risk of an existing or future sinkhole is to construct the development at a site that is not underlain by karst susceptible bedrock.

4.3. Excavations

Excavations into the overburden materials would be practical with conventional excavators. As a minimum, excavations should conform to the regulations of the Nova Scotia Occupational Health and Safety Act. For temporary construction excavations, slopes of 1.5H:1V should be attainable in the glaciofluvial sand, and material should not be stockpiled closer than 3 m from the crest of the excavation. Flatter slopes may be required if excessive groundwater seepage is encountered.

Excavation close to foundation level should be done carefully to avoid excessive disturbance of the soil. It is essential to prevent the soil at foundation level from deteriorating due to excessive wetting from surface or the seepage of water. Surface drainage away from the footing trenches during construction is essential. In the event that foundation construction is delayed after excavation, the footing trenches should be protected from weathering to prevent the deterioration of the soil at footing level.

Excavation dewatering will be required during construction, and dewatering by sumps and pumps should be practical; all dewatering work should, as a minimum, conform to Nova Scotia Department of Environment and Labour (NSDEL) standard practices and regulations.

4.4. Site Grading Fill Materials

Fill materials used for site grading should be compacted to the following percentages of Standard Proctor Maximum Dry Density (SPMDD):

- Structural fill beneath building areas – 100 %.
- Fill within 300 mm of pavement subgrade – 98 %.
- Fill greater than 300 mm of pavement subgrade – 95 %.

4.4.1. Structural Fill

Structural fill should consist of a common “pit-run” granular fill and have the following specifications:

- Hard, durable material with maximum 35% loss by Micro Duval.
- Maximum particle size 150 mm.
- 75% of particles to be greater than 75 mm

- Maximum “fines” content 10%.
- Moderately well graded.
- No deleterious, organic content.

Placement and compaction of all structural fill should be performed in lifts where thicknesses used are compatible with the compaction equipment and material type to ensure the required density throughout. Generally, the compacted lift thickness should be less than 300 mm with the use of a 10-tonne, vibratory roller.

4.4.2. Reuse of Onsite Materials

Excavated glaciofluvial sand from cut areas above the water table should be suitable for re-use as subgrade fill in driveway/parking areas. Some of this material may initially be too wet for use; however, under adequate drying conditions this material would be suitable. Due to the higher moisture contents noted and variable fines content, it is not recommended to reuse this material as structural fill.

The clay soils are not considered suitable for reuse as structural fill, or site grading and should be wasted, or used in landscaped areas only.

4.5. Foundations

Based on the, field investigation, and our local experience, conventional spread footings, concrete slabs-on-grade, and asphalt pavement structures are considered suitable for construction provided that the following geotechnical recommendations are considered.

4.5.1. Foundation Subgrade

It is important that footings be founded on a suitable bearing stratum comprised of undisturbed compact glaciofluvial sand, glacial till, or bedrock. Where required, compacted structural fill can be placed over these materials to reach footing subgrade. All exterior footings should be placed at a minimum depth of 1.5 m for frost protection. Based on a FFE of 50.75 m this would result in a design elevation of 49.25 m.

Excavations to suitable bearing stratum in the south area of the building will need to extend deeper than the minimum footing depth, specifically in proximity to TP-BGC14-05 and -06 to remove all soft clay material within the building footprint. In this case, up to 2.5 m of suitable structural fill may be required to backfill any areas up to the proposed minimum footing depth. All structural fill below footing level should extend beyond the footing perimeter a distance at least equal to 1 m plus the depth of the structural fill below the footings. It is suggested that excavations in this area be conducted in a manner to first identify the lateral and vertical extent of the clay soils for removal. Should a more accurate delineation of the depth and extent of the clay material be required, BGC would be pleased to provide further subsurface investigation prior to construction. All excavations should be conducted under the supervision of qualified geotechnical personnel and footing subgrades shall be approved prior placement

of structural fill and concrete formwork. All structural fill should be placed and compacted as outlined in Section 4.4.

It is recommended that 200 mm of NSTIR Type 2 be placed beneath all footing to provide a uniform bearing surface. The Type 2 should be compacted to 100% SPMDD.

4.5.2. Spread Footings

Square and strip spread footings placed on prepared foundations subgrade can be designed using an Ultimate Limit State of 450 kPa. A resistance factor of 0.5 is recommended for design. A Serviceability Limit State (SLS) of 150 kPa is recommended. The total and differential settlement associated with the SLS bearing pressure should be less than 25 mm and 19 mm, respectively provided unsuitable native soils are removed as per Section 4.5.1.. Footings designed in accordance with Section 4.5.1 and the above must have a minimum width of 0.6 m and a maximum width of 3 m.

4.5.3. Foundation Walls and Backfill

It is recommended that perimeter drainage of the foundation walls be provided to intercept water entering into the building footprint from groundwater, or due to precipitation. Perimeter drains should be provided with a positive outlet to ditches or sumps. The drain must be placed at the base of the footing and should consist of a 100 mm diameter rigid perforated PVC pipe surrounded by a minimum of 150 mm of 19 mm clear crushed gravel such as NSTIR C5 or equivalent. It is important to provide proper filtering between the new drain and the native site materials to prevent plugging of the system; the clearstone gravel should be separated from native soils by a geotextile drainage filter. It is recommended that the ground surface outside of the exterior walls is graded away from the foundation walls to shed surface runoff away from the building.

Ideally, backfill against the exterior concrete walls above the drain should ideally consist of free draining clean granular material with particle size less than 75 mm. However, the onsite glaciofluvial sand is considered suitable as backfill provided it can be compacted to 95% SPMDD.

Wall backfill should not be placed until basement walls are braced or until the concrete has sufficient strength to withstand the earth pressures resulting from placement and compaction. Compaction in the vicinity of basement walls should be carried out using only light compaction equipment and care should be taken not to over-compact and distress the walls.

4.5.4. Concrete Slabs

Concrete floor slabs can be constructed as grade supported provided the following recommendations are considered.

Subgrade for concrete slabs should be constructed in accordance with Section 4.5.1 including removal of all the soft clay material. All fill required to raise grades below floor slabs must be structural fill compacted to at least 100% of SPMDD.

A minimum of 200 mm of Type 1 granular base compacted to 98% SPMDD is recommended immediately beneath the floor slab as leveling course. For concrete slabs constructed as outlined above, a modulus of subgrade reaction of 55 MPa/mm can be used for design purposes.

Quality control inspection, density testing of the prepared subgrade should be carried out by geotechnical personnel during construction.

4.6. Seismic Site Classification

Based on the soil properties expected within the upper 30 m and also considering the recommendations provided above, the recommended Site Classification for Seismic Site Response (Table 4.1.8.4.A of the 2010 National Building Code of Canada) is considered as “Site Class C – Very Dense Soil or Soft Rock” (NBCC, 2010).

4.7. Pavement

Fill materials required to raise site grades for paved areas should be comprised of material suitable for attaining the specified compaction levels in Section 4.4. Subgrade preparation should include proof rolling of the exposed subgrade with a minimum six (6) passes of a 10 ton vibratory steel drum roller. Areas of weak subgrade material identified during proof rolling should be removed and replaced with a granular fill compacted to 98% SPMDD and meeting NSTIR Type 2 specifications.

The following pavement designs are the minimum recommended for placement over prepared subgrades.

Table 4-1. Pavement Structure.

Material	Standard Duty Pavement	Heavy Duty Pavement
Ashphalt Concrete, Type C	65 mm	90 mm
Granular Base , Type 1	150 mm	200 mm
Granular Subbase, Type 2	300 mm	300 mm

All base course material and workmanship are to be in accordance with the NSTIR Standard Specification and should be compacted to 100% SPMDD.

4.8. Winter Construction

Site earthworks associated with the construction of the building expansion may occur over winter months. A cold weather earthworks and concrete placement procedure plan should be developed prior to any construction at the site during winter months. Based on previous project experience, hoarding and heat application is necessary over excavations for foundations to help prevent freezing before cover, and as well, ensure proper temperatures for concrete curing. In addition, fill materials stockpiled and/or placed during winter months are prone to

freezing and it is recommended that prior to placement that all frozen materials are removed or heated.

5.0 CLOSURE

We trust the above satisfies your requirements at this time. Should you have any questions or comments, please do not hesitate to contact us.

Yours sincerely,

BGC ENGINEERING INC.

per:

Anthony Urquhart, M.Eng., P.Eng
Geotechnical Engineer

Reviewed by:

Edward Carey, P.Eng.
Senior Geotechnical Engineer

AKU/EC/EC/lw

REFERENCES

Keppie, J. 2006. Geological Map of the Province of Nova Scotia. NSDNR Map ME 2000-1. Scale 1:500 000. Digital Geoscience Data Product DP ME 43, Version 2.

Lin, S. 1992. The Structural Geology of Southeastern Cape Breton Highlands National Park, Nova Scotia; Geological Survey of Canada, Open File 2568, Scale 1:30 000

NBCC. 2010. National Building Code of Canada, Associate Committee on the National Building Code, National Research Council of Canada, Ottawa, Ont.

Stea, R. et al. 1992. Surficial Geology Map of the Province of Nova Scotia, NSDNR Map ME 1992-3. Scale 1:500 000. Digital Geoscience Data Product DP ME 36, Version 2, 2006.

PHOTOGRAPHS



Photo 1.
TP-BGC14-01

Seepage at 2.6 m depth



Photo 2.
TP-BGC14-01

Glaciofluvial Sand



Photo 3.
TP-BGC14-02

Glaciofluvial Sand at 2 m depth. Seepage from upper 0.2 to 0.3 m.



Photo 4.
TP-BGC14-03

Glaciofluvial Sand at 2 m depth. Seepage from upper 0.6 to 0.7 m.



Photo 5.
TP-BGC14-03

Glaciofluvial Sand



Photo 6.
TP-BGC14-04

Glaciofluvial Sand at 2 m depth. Seepage from upper 0.6 to 0.7 m



Photo 7.
TP-BGC14-05

Glaciofluvial Sand at 1.5 m depth.



Photo 8.
TP-BGC14-05

Clay Soil at 2 m depth



Photo 9.
TP-BGC14-06

Glaciofluvial Sand Over Clay Soil at 2 m depth.



Photo 10.
TP-BGC14-06

High Manganese Content Clay Soil at 2 m depth.



Photo 11.
TP-BGC14-06

Limestone Bedrock at 4.3 m depth.



Photo 12.
TP-BGC14-07

Glaciofluvial Sand at 2 m depth. Seepage from upper 0.6 to 0.7 m.

APPENDIX A TEST PIT LOGS

Survey Method: Handheld GPS
Coordinates (m): 4587011E, 5174610N
Ground Elevation (m): 50.2
Datum: ATS77

Excavator: CAT 312
Operator: E. MacLean

Start Date: 07 May 14
Finish Date: 07 May 14
Final Depth of Pit (m): 2.80
Logged by: RLC
Reviewed by: AKU

Depth (m)	Sample Type	Sample No.	Symbol	Lithological Description	Instrument Details	Su (kPa)				Lab Tests and Comments	Elevation (m)
						50	100	150	200		
						Moisture Content					
						W _p %	W _L %	W _p %	W _L %		
						X	—	O	—	X	
						20	40	60	80		
0				TOPSOIL (0 – 0.05 m) Moss and Organics							
				SAND (SM) (0.05 – 0.3 m) Fine grained, silty, poorly graded, loose, subangular and subrounded particles, orangish brown, very moist, weathered							50
	G	G1		SAND (SM) (0.3 – 1.2 m) Fine and medium grained, gravelly, trace silt, trace cobbles, poorly graded, compact to dense (becomes dense at 0.5 m depth), subangular and subrounded particles, light brown, moist						MC: 12.6%	49
				SAND (SM) (1.2 – 2.8 m) Medium and coarse grained, some gravel to gravelly, trace silt, trace cobbles and boulders (boulders to 0.6 m in size), poorly graded, compact, subangular and subrounded particles, light brown, very moist						MC: 11.9% Grain Size Analysis: 10.3% Gravel, 79.1% Sand, 10.6% Silt and Clay	48
	G	G2									
				- groundwater seepage at 2.6 m							
3				INFERRRED BEDROCK (2.8 m) Light grey, coarse grained with fine and medium grained gravel inclusions, R1 – R2 [CONGLOMERATE]							47
				END OF TEST PIT AT 2.8 m NOTES: 1) Significant to moderate seepage throughout upper 0.2 – 0.4 m of test pit. Source is surface water infiltration 2) Excavator refusal at 2.8 m							
4											46
5											45
6											

NS (TESTPIT) - NEW_DSRA_TESTPIT_GDL_BGC_GDT_5/28/14

Survey Method: Handheld GPS
Coordinates (m): 4586986E, 5174604N
Ground Elevation (m): 51.2
Datum: ATS77

Excavator: CAT 312
Operator: E. MacLean

Start Date: 07 May 14
Finish Date: 07 May 14
Final Depth of Pit (m): 4.00
Logged by: RLC
Reviewed by: AKU

Depth (m)	Sample Type	Sample No.	Symbol	Lithological Description	Instrument Details	Su (kPa)				Lab Tests and Comments	Elevation (m)
						50	100	150	200		
						Moisture Content					
						W _p %	W%	W _L %			
						×	○	×			
						20	40	60	80		
0				TOPSOIL (0 – 0.05 m) Moss and Organics							
				SAND (SM) (0.05 – 0.3 m) Fine grained, silty, poorly graded, loose, subangular and subrounded particles, orangish brown, very moist, weathered							
				SAND (SM) (0.3 – 4.0 m) Fine and medium grained, some gravel, trace to some silt, trace cobbles, poorly graded, loose compact subangular and subrounded particles, light brown, very moist to wet, sand becomes medium and coarse grained with depth - becomes compact and moist at 0.5 m						MC: 13.6% Grain Size Analysis: 19.3% Gravel, 61.5% Sand, 19.1% Silt and Clay	51
1	G	G1									50
2											49
	G	G2								MC: 12.2%	48
3											
4				INFERRED BEDROCK (4 m) END OF TEST PIT AT 4.0 m NOTES: 1) Significant seepage throughout upper 0.2 – 0.3 m . Source is surface water infiltration 2) Excavator refusal at 4.0 m.							47
5											46
6											

NS TESTPIT - NEW_DSRA_TESTPIT_GDL_BGC_GDT_5/28/14

Survey Method: Handheld GPS
Coordinates (m): 4586993E, 5174581N
Ground Elevation (m): 51.3
Datum: ATS77

Excavator: CAT 312
Operator: E. MacLean

Start Date: 07 May 14
Finish Date: 07 May 14
Final Depth of Pit (m): 3.20
Logged by: RLC
Reviewed by: AKU

Depth (m)	Sample Type	Sample No.	Symbol	Lithological Description	Instrument Details	Su (kPa)				Lab Tests and Comments	Elevation (m)
						50	100	150	200		
						Moisture Content					
						W _p %	W _p %	W _p %	W _p %		
						20	40	60	80		
0				TOPSOIL (0 – 0.05 m) Moss and Organics							
				SAND (SM) (0.05 - 0.5 m) Fine grained, some silt, trace gravel, poorly graded, loose, subangular and subrounded particles, orangish brown, very moist, weathered							51
1	G	G1		SAND (SP) (0.5 - 1.0 m) Medium and coarse grained, some gravel to gravelly, trace silt, trace cobbles, poorly graded, loose to compact, subrounded particles, light brown, wet - becomes compact at 0.8 m						MC: 10.9%	
2	G	G2		SAND (SM) (1.0 - 3.2 m) Fine and medium grained, trace to some gravel, trace to some silt, trace cobbles, poorly graded, compact, subangular and subrounded particles, light brown, moist						MC: 11.9% Grain Size Analysis: 12.3% Gravel, 67.3% Sand, 20.4% Silt and Clay	50
3											49
4				END OF TEST PIT AT 3.2 m NOTES: 1) Significant to moderate seepage throughout upper 0.6 – 0.7 m. Source is surface water infiltration							48
5											47
6											46

NS (TESTPIT) - NEW_DSRA_TESTPIT_GDL_BGC_GDT_5/28/14

Survey Method: Handheld GPS
Coordinates (m): 4586969E, 5174576N
Ground Elevation (m): 52.6
Datum: ATS77

Excavator: CAT 312
Operator: E. MacLean

Start Date: 07 May 14
Finish Date: 07 May 14
Final Depth of Pit (m): 2.90
Logged by: RLC
Reviewed by: AKU

Depth (m)	Sample Type	Sample No.	Symbol	Lithological Description	Instrument Details	Su (kPa)				Lab Tests and Comments	Elevation (m)
						50	100	150	200		
						Moisture Content					
						W _c %	W%	W _c %			
						×	○	×			
						20	40	60	80		
0				TOPSOIL (0 – 0.05 m) Moss and Organics							
				SAND (SM) (0.05 - 0.5 m) Fine grained, silty, poorly graded, loose, subangular and subrounded particles, orangish brown, very moist, weathered							
	G	G1		SAND (SM) (0.5 - 1.4 m) Medium and coarse grained, some gravel to gravelly, trace to some silt, trace cobbles, poorly graded, compact, subrounded particles, light brown, wet		○				MC: 15.8% Grain Size Analysis: 30.3% Gravel, 58.1% Sand, 11.6% Silt and Clay	52
				SAND (SP) (1.4 - 2.9 m) Fine and medium grained, some gravel, trace silt, trace cobbles, poorly graded, compact, subangular and subrounded particles, light brown, very moist		○				MC: 10.8%	51
	G	G2									50
3				END OF TEST PIT AT 2.9 m NOTES: 1) Significant to moderate seepage throughout upper 0.6 – 0.7 m. Source is surface water infiltration.							49
4											48
5											47
6											

NS TESTPIT - NEW DSRA TESTPIT.GDL BGC.GDT 5/28/14

Survey Method: Handheld GPS
Coordinates (m): 4587037E, 5174585N
Ground Elevation (m): 49.3
Datum: ATS77

Excavator: CAT 312
Operator: E. MacLean

Start Date: 07 May 14
Finish Date: 07 May 14
Final Depth of Pit (m): 3.50
Logged by: RLC
Reviewed by: AKU

Depth (m)	Sample Type	Sample No.	Symbol	Lithological Description	Instrument Details	Su (kPa)				Lab Tests and Comments	Elevation (m)
						50	100	150	200		
						Moisture Content					
						W _p %	W _L %	W _p %	W _L %		
						×	○	○	×		
						20	40	60	80		
0				TOPSOIL (0 – 0.05 m) Moss and Organics							
				SAND (SM) (0.05 - 0.3 m) Fine grained, some silt, trace gravel, poorly graded, loose, subangular and subrounded particles, orangish brown, very moist,							49
	G	G1		SAND (SM) (0.3 - 0.8 m) Fine grained, silty, some gravel, trace cobbles and boulders to 0.4 m in size, poorly graded, compact, angular particles, light brown, moist		○				MC: 14.1%	
1				SAND (SM) (0.8 - 2 m) Medium grained, trace to some silt, some gravel, trace cobbles, poorly graded, compact, subangular and subrounded particles, light brown, wet							48
	G	G3				○				MC: 13.1%	
2				CLAY (CI) (2.0 - 2.2 m) Silty, medium plastic, dark grey, trace sand, soft, very moist, includes isolated pockets of very soft, wet						MC: 16.9%	
	G	G2				○				Grain Size Analysis: 8.9% Gravel, 44.8% Sand, 46.3% Silt and Clay	47
				SAND (SM) (2.2 - 3.5 m) Silty, fine grained, some gravel, trace cobbles, poorly graded, compact to dense, subangular and subrounded particles, brownish grey, moist [GLACIAL TILL]							46
3											
4				END OF TEST PIT AT 3.5 m NOTES: 1) Significant to moderate seepage throughout upper 0.3 – 0.6 m. Source is surface water infiltration							45
5											44
6											

NS (TESTPIT)-NEW_DSRA_TESTPIT_GDL_BGC_GDT_5/28/14



BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

Client: DSRA Architecture
 Print Date: 5/28/2014

- Su Symbol**
- ◇ VANE(PEAK)
 - ◆ VANE(RES.)
 - UCS/2
 - △ PP/2

All noted depths are in metres along hole.

Survey Method: Handheld GPS
Coordinates (m): 4587021E, 5174567N
Ground Elevation (m): 49.8
Datum: ATS77

Excavator: CAT 312
Operator: E. MacLean

Start Date: 07 May 14
Finish Date: 07 May 14
Final Depth of Pit (m): 4.30
Logged by: RLC
Reviewed by: AKU

Depth (m)	Sample Type	Sample No.	Symbol	Lithological Description	Instrument Details	Su (kPa)				Lab Tests and Comments	Elevation (m)
						50	100	150	200		
						Moisture Content					
						W _p %	W _l %	W _u %	W _u %		
						20	40	60	80		
0				TOPSOIL (0 – 0.05 m) Moss and Organics							
				SAND (SM) (0.05 - 0.5 m) Fine grained, some silt, some gravel, poorly graded, loose, subangular and subrounded particles, orangish brown, very moist, weathered							
	G	G1		SAND (SM) (0.5 - 2.0 m) Fine and medium grained, silty, some gravel, trace cobbles, poorly graded, compact, subangular and subrounded particles, light brown, very moist						MC: 13.6%	49
2	G	G3		CLAY (CH) (2.0 - 3.4 m) Silty, high plastic, dark dark grey to black, trace sand, very soft to soft, wet, includes inclusions (stringers) of weathered, very weak, limestone						MC: 67.3% Grain Size Analysis: 0.2% Gravel, 38.5% Sand, 61.4% Silt and Clay Manganese: 18000 mg/kg	48
				- groundwater seepage at 2.7 m							47
4	G	G2		SAND and SILT (SM) (3.4 - 4.3 m) Fine grained, silty, some gravel, trace cobbles, poorly graded, compact to dense, subangular and subrounded particles, brownish grey, moist [GLACIAL TILL]						MC: 18.5%	46
5				INFERRED BEDROCK (4.3m) Fine grained, grey white, strong reaction with HCL, some ironstaining R2 [LIMESTONE]							45
				END OF TEST PIT AT 4.3 m NOTES: 1) Significant to moderate seepage throughout upper 0.6 – 0.7 m. Source is surface water infiltration. 2) Excavator refusal at 4.3 m							44

NS (TESTPIT) - NEW_DSRA_TESTPIT_GDL_BGC_GDT_5/28/14

Survey Method: Handheld GPS
Coordinates (m): 4587009E, 5174575N
Ground Elevation (m): 50.8
Datum: ATS77

Excavator: CAT 312
Operator: E. MacLean

Start Date: 07 May 14
Finish Date: 07 May 14
Final Depth of Pit (m): 3.80
Logged by: RLC
Reviewed by: AKU

Depth (m)	Sample Type	Sample No.	Symbol	Lithological Description	Instrument Details	Su (kPa)				Lab Tests and Comments	Elevation (m)
						50	100	150	200		
						Moisture Content					
						W _p %	W _L %	W _p %	W _L %		
						X	—	O	—	X	
						20	40	60	80		
0				TOPSOIL (0 – 0.05 m) Moss and Organics							
0.5				SAND (SM) (0.2 - 0.5 m) Fine grained, some silt, trace gravel, poorly graded, loose, subangular and subrounded particles, orangish brown, very moist, weathered							
1				SAND (SM) (0.5 - 2.4 m) Fine and medium grained, some silt, some gravel, trace cobbles, poorly graded, compact, subangular and subrounded particles, light brown, very moist							50
2											49
3				SAND (SM) (2.4 - 3.8 m) Silty, fine grained, some gravel, trace cobbles, poorly graded, compact to dense, subangular and subrounded particles, brownish grey, moist [GLACIAL TILL]							48
4				INFERRED BEDROCK (3.8 m) END OF TEST PIT AT 3.8 m NOTES: 1) Significant to moderate seepage throughout upper 0.6 - 0.7 m. Source is surface water infiltration. 2) Excavator refusal at 3.8 m							47
5											46
6											45

NS (TESTPIT)-NEW_DSRA_TESTPIT_GDL_BGC_GDT_5/28/14

APPENDIX B SEISMIC HAZARD

Natural Resources Canada

[Natural Resources Canada](#) > [Hazards](#) > [Natural Hazards](#) > Earthquakes

Determine 2010 National Building Code of Canada seismic hazard values

Latitude and longitude values should be entered in decimal degree (DD.DDDD) or degree:minute:second (DD:MM:SS.S) format. UTM coordinates can be converted to latitude and longitude using the Canadian Spatial Reference System Service's online [GSRUG](#) application.

For more information see [seismic hazard in Canada](#)

[Supporting documentation and calculators for other editions of the code](#)

2010 National Building Code of Canada seismic hazard calculator

[Jump to search results](#)

Latitude

Longitude (in Canada should be entered as negative values)

Number of closest points for interpolation

 ▼

Parameter to display on map (values for all 5 parameters will be determined)

 ▼

Enter location place name (optional)

Type of structure (optional)

Company/Organization (optional)

Name (optional)

Email (optional)

Personal Information Collection Statement

The personal information you provide using the seismic hazard calculator form for the seismic hazard calculator is collected under the authority of the Resources and Technical Surveys Act and will be used by Natural Resources Canada to conduct research into earthquakes in Canada. The information may also be used to contact you for follow-up research or to confirm the data provided.

Please note that the information you provide using the seismic hazard calculator may be routed through an American or other internationally-based server. However, in the event that this occurs, the information will be deleted from the American or internationally-based server after one week.

There are no legal or administrative consequences for refusing to provide the personal information requested. Under the Privacy Act, you have rights of access to, correction of, and protection of personal information.

The information you provide using this form is described in the following standard Personal Information Bank (PIB): Public Communications - PSU 914. For more information about this PIB and your privacy rights, please consult Info Source: Sources of Federal Government and Employee Information, which is published on the Internet by the Treasury Board of Canada Secretariat at: <http://infosource.gc.ca/index-eng.asp>.

Calculate

Page will reload with results inserted at the end of the page under the heading "Search Results"

Search Results

2010 National Building Code of Canada interpolated seismic hazard values

Determined for a 2% in 50 year (0.000404 per annum) probability of exceedence. Values are for "firm ground" (NBCC 2010 soil class C - average shear wave velocity 360-750 m/s). Median (50th percentile) values are given in units of g for spectral acceleration (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA). Only 2 significant figures are to be used.

[These values have been interpolated Using Shepards method from a 10 km spaced grid of points.](#) Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the calculated values.

Site Coordinates: **46.7 °N 60.36°W**

User File Reference: **Ingonish**

Requested by: ,

National Building Code interpolated seismic hazard values

2%/50 years (0.000404 per annum) probability

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA
0.156 g	0.109 g	0.068 g	0.023 g	0.055 g

Interpolated seismic hazard values at other probabilities

40%/50 years (0.01 per annum)

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA
0.025 g	0.018 g	0.011 g	0.004 g	0.007 g

10%/50 years (0.0021 per annum)

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA
0.067 g	0.049 g	0.031 g	0.011 g	0.021 g

5%/50 years (0.001 per annum)

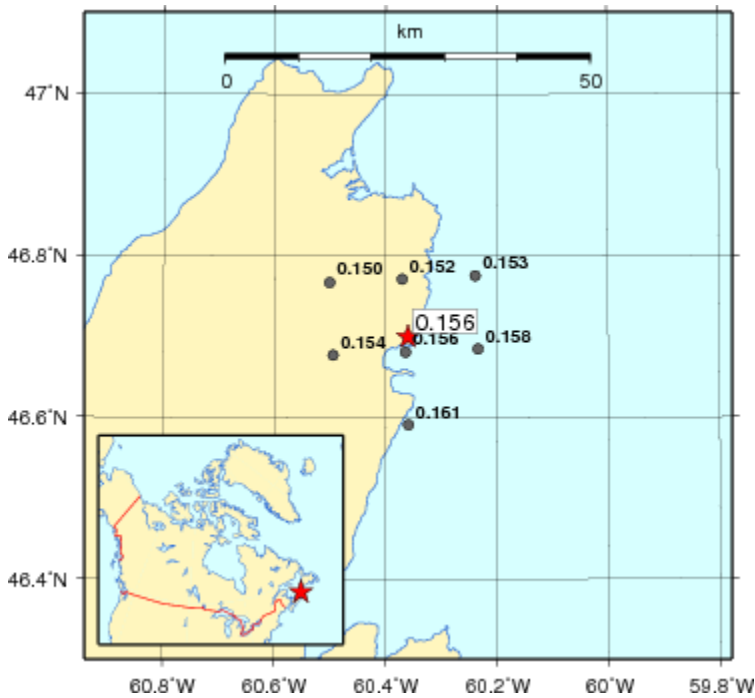
Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA

Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA
0.100 g	0.072 g	0.047 g	0.015 g	0.032 g

[Generate a pdf version of the interpolated NBCC 2010 values](#)

Nearby points values for National Building Code probabilities

Distance		Latitude	Longitude	Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)	PGA
13.076	km	46.767	-60.501	0.150	0.107	0.067	0.022	0.053
12.433	km	46.775	-60.239	0.153	0.108	0.068	0.022	0.054
12.121	km	46.591	-60.359	0.161	0.112	0.069	0.023	0.057
10.611	km	46.677	-60.495	0.154	0.109	0.068	0.023	0.054
9.754	km	46.685	-60.234	0.158	0.110	0.069	0.023	0.056
7.932	km	46.771	-60.370	0.152	0.107	0.068	0.022	0.053
2.135	km	46.681	-60.364	0.156	0.109	0.068	0.023	0.055
Interpolated		46.7	-60.36	0.156	0.109	0.068	0.023	0.055



Date modified: 2013-07-23

APPENDIX C LABORATORY REPORTS

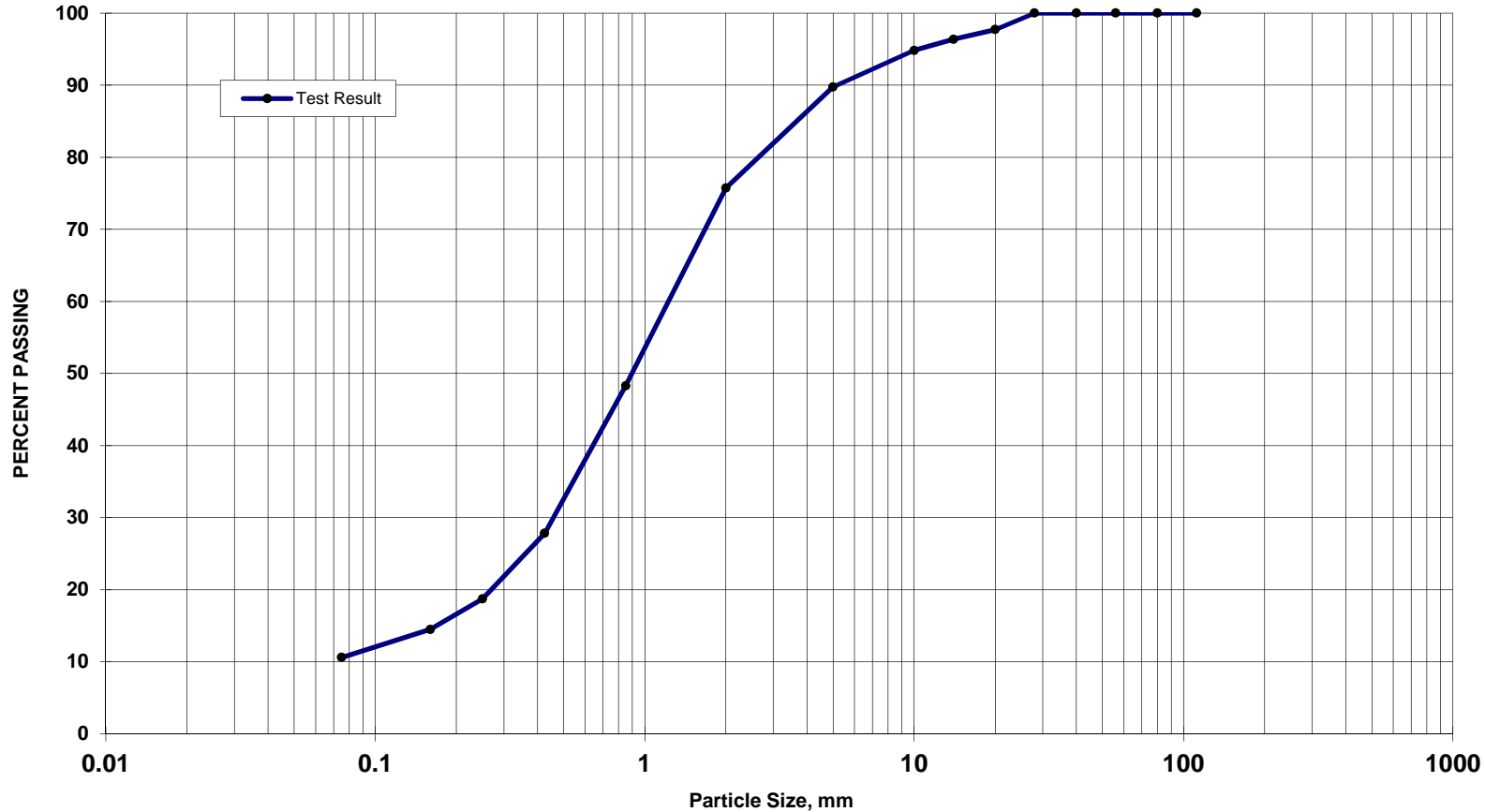


ASTM/USCS Sieve Analysis

BGC-Materials Testing Services 2013-2014

SYD-00216254-A0

7-May-14



TEST DATA	
Sieve Size (mm)	Percent Passing (%)
112	100.0
80	100.0
56	100.0
40	100.0
28	100.0
20	97.7
14	96.4
10	94.8
5	89.7
2	75.7
0.85	48.3
0.425	27.8
0.25	18.7
0.16	14.5
0.075	10.6

Client: BGC Engineering Inc.

Gravel (%) 10.3

C_u n/a

Sample: TP-1 (SA#2 at 2.0 m depth)

Sand (%) 79.1

C_c n/a

Soil Type: Not Reported to exp

Fines (%) 10.6

$W_{content}(\%)$ 11.9

Poorly graded sand

USCS Soil Name: with silt

USCS Symbol: SP-SM

Test By: TY/DM

Specified Gradational Limits		
Size (mm)	Low Limit % Passing	High Limit % Passing
80		
56		
28		
14		
5		
0.16		
0.08		

Comment: Fines are assumed to be classified as ML (silt). Clients PO Number is 1389-001

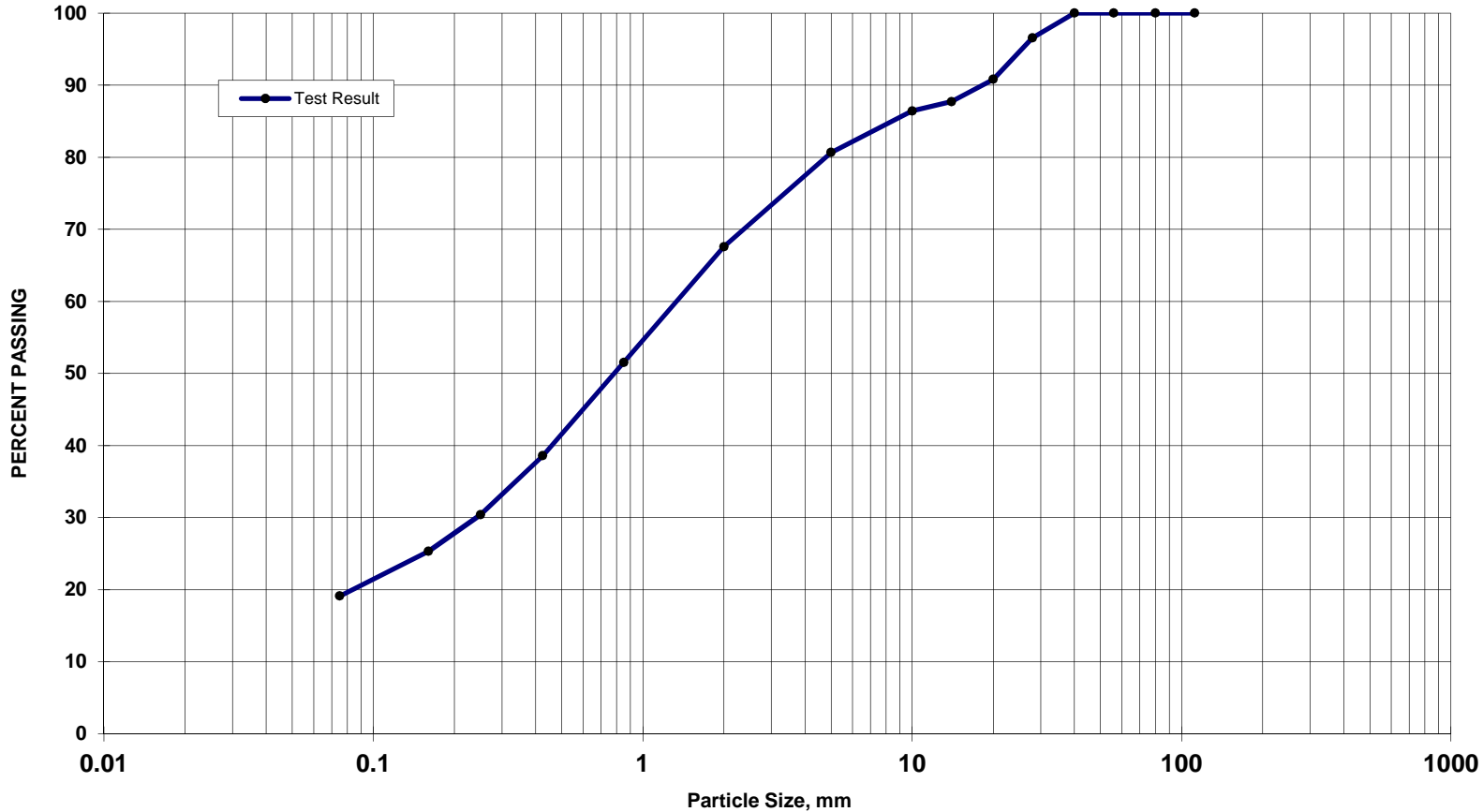


ASTM/USCS Sieve Analysis

BGC-Materials Testing Services 2013-2014

SYD-00216254-A0

7-May-14



TEST DATA	
Sieve Size (mm)	Percent Passing (%)
112	100.0
80	100.0
56	100.0
40	100.0
28	96.6
20	90.8
14	87.7
10	86.4
5	80.7
2	67.6
0.85	51.5
0.425	38.6
0.25	30.4
0.16	25.3
0.075	19.1

Client: BGC Engineering Inc. Gravel (%) 19.3 C_u n/a
 Sample: TP-2 (SA#1 at 1.0 m depth) Sand (%) 61.5 C_c n/a
 Soil Type: Not Reported to exp Fines (%) 19.1 $W_{content}(\%)$ 13.6
 USCS Soil Name: Silty sand with gravel USCS Symbol: SM Test By: TY/DM

Specified Gradational Limits		
Size (mm)	Low Limit % Passing	High Limit % Passing
80		
56		
28		
14		
5		
0.16		
0.08		

Comment: Fines are assumed to be classified as ML (silt). Clients PO Number is 1389-001

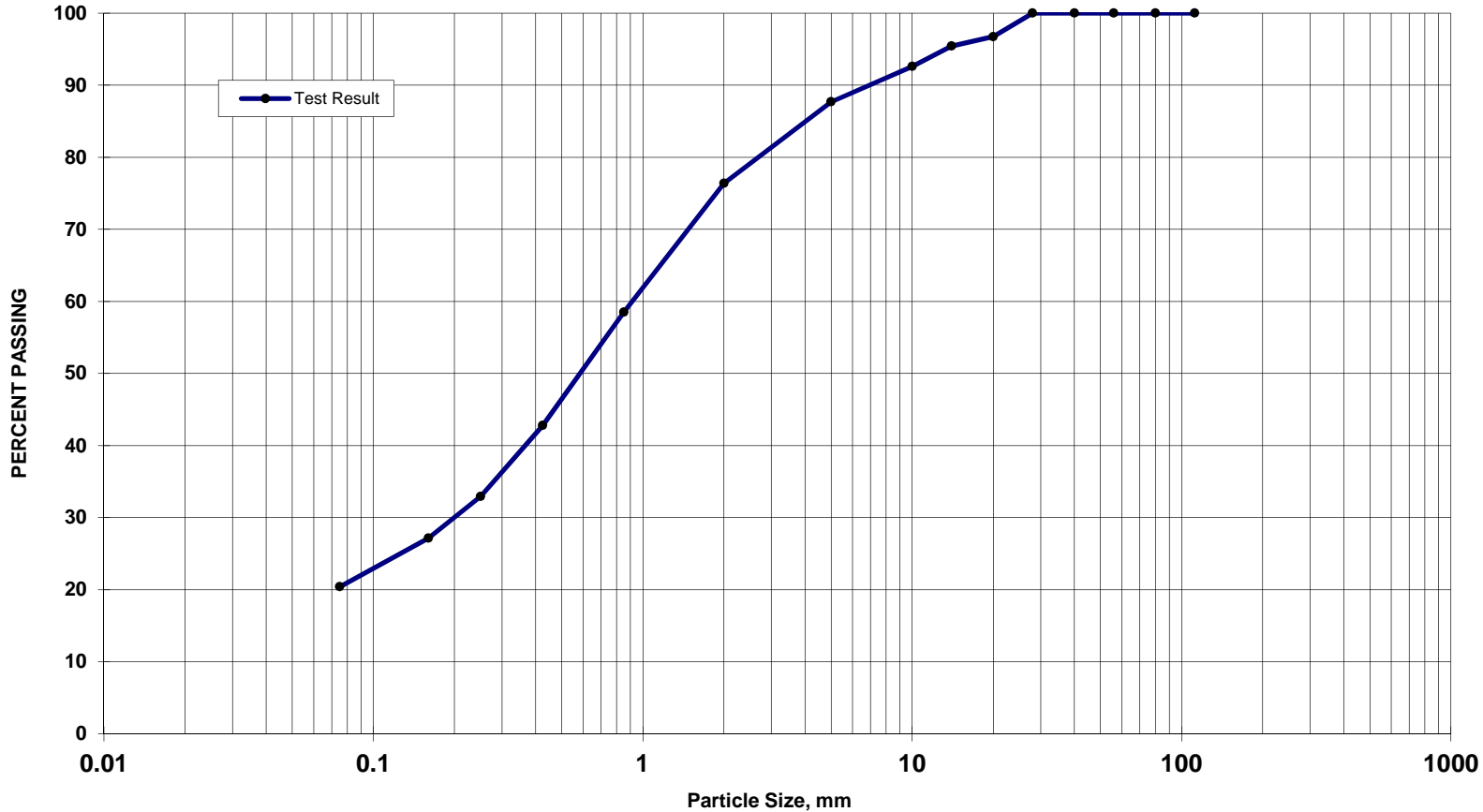


ASTM/USCS Sieve Analysis

BGC-Materials Testing Services 2013-2014

SYD-00216254-A0

7-May-14



TEST DATA	
Sieve Size (mm)	Percent Passing (%)
112	100.0
80	100.0
56	100.0
40	100.0
28	100.0
20	96.7
14	95.4
10	92.6
5	87.7
2	76.4
0.85	58.5
0.425	42.8
0.25	33.0
0.16	27.1
0.075	20.4

Client: BGC Engineering Inc. Gravel (%) 12.3 C_u n/a
 Sample: TP-3 (SA#2 at 1.7 m depth) Sand (%) 67.3 C_c n/a
 Soil Type: Not Reported to exp Fines (%) 20.4 $W_{content}(\%)$ 11.9
 USCS Soil Name: Silty sand USCS Symbol: SM Test By: TY/DM
 Comment: Fines are assumed to be classified as ML (silt). Clients PO Number is 1389-001

Specified Gradational Limits		
Size (mm)	Low Limit % Passing	High Limit % Passing
80		
56		
28		
14		
5		
0.16		
0.08		

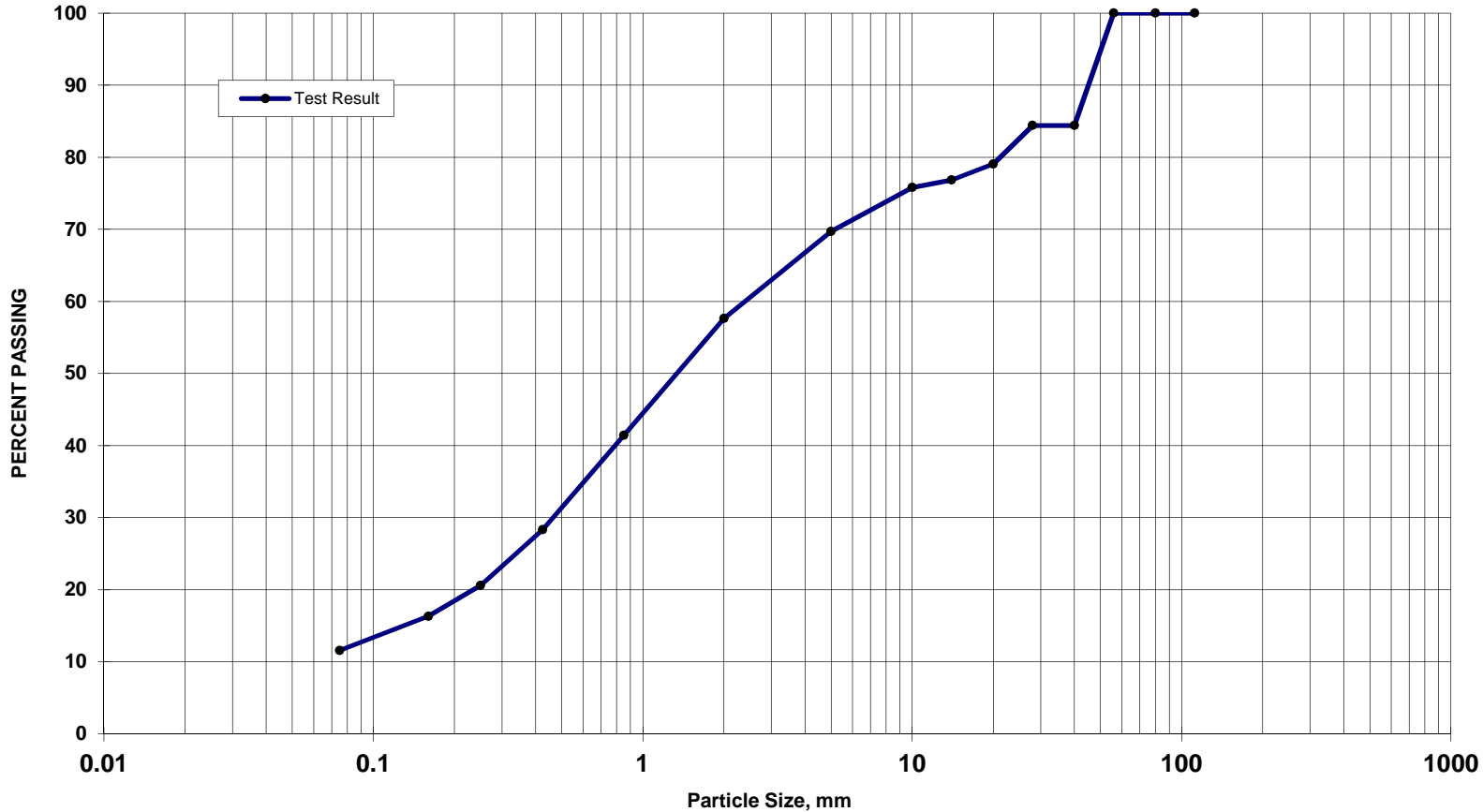


ASTM/USCS Sieve Analysis

BGC-Materials Testing Services 2013-2014

SYD-00216254-A0

7-May-14



TEST DATA	
Sieve Size (mm)	Percent Passing (%)
112	100.0
80	100.0
56	100.0
40	84.4
28	84.4
20	79.1
14	76.8
10	75.8
5	69.7
2	57.6
0.85	41.4
0.425	28.4
0.25	20.6
0.16	16.3
0.075	11.6

Specified Gradational Limits		
Size (mm)	Low Limit % Passing	High Limit % Passing
80		
56		
28		
14		
5		
0.16		
0.08		

Client: BGC Engineering Inc.

Gravel (%) 30.3

C_u n/a

Sample: TP-4 (SA#1 at 0.7 m depth)

Sand (%) 58.1

C_c n/a

Soil Type: Not Reported to exp

Fines (%) 11.6

$W_{content}(\%)$ 15.8

Poorly graded sand

USCS Soil Name: with silt and gravel

USCS Symbol: SP-SM

Test By: TY/DM

Comment: Fines are assumed to be classified as ML (silt). Clients PO Number is 1389-001

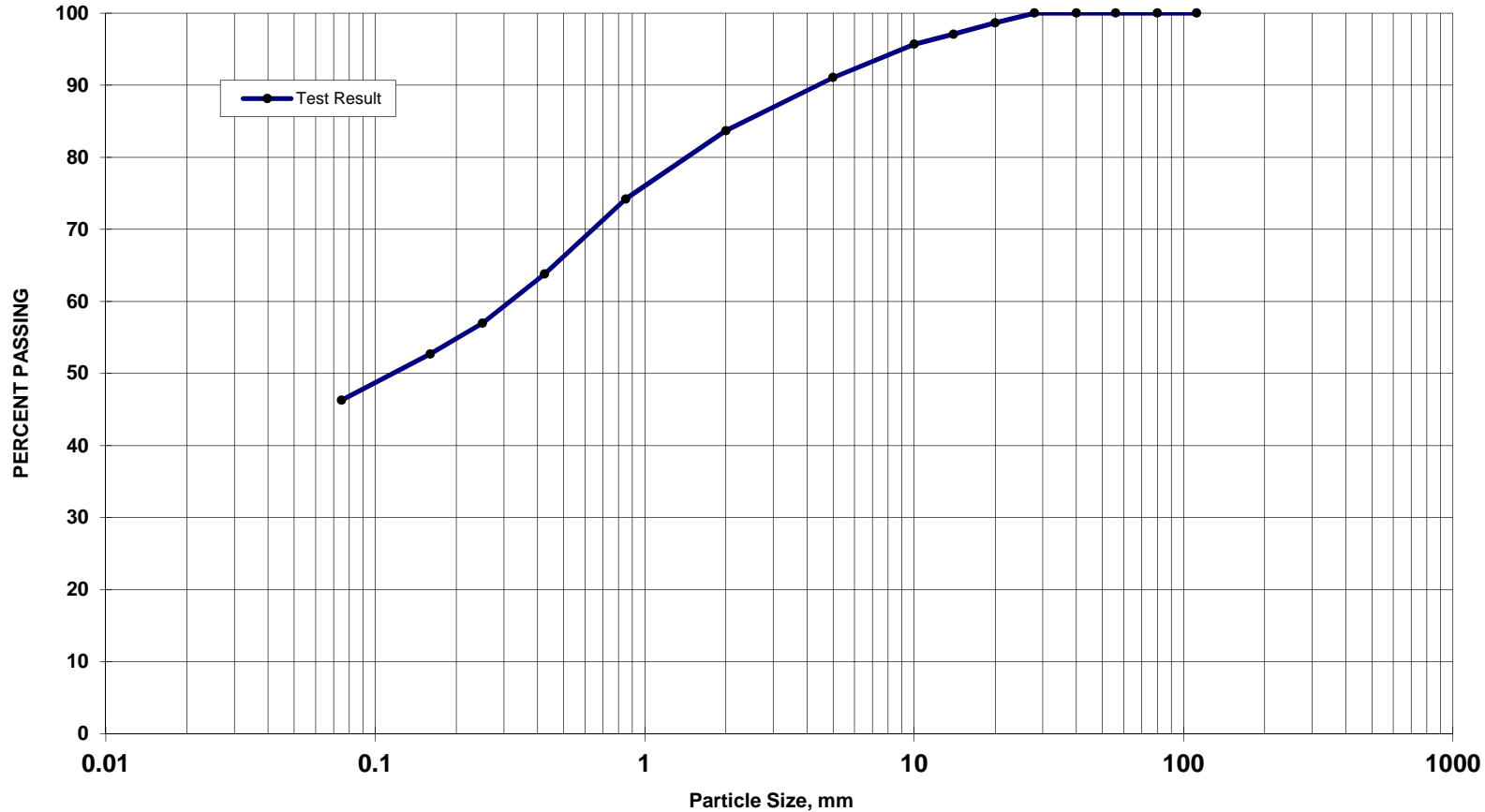


ASTM/USCS Sieve Analysis

BGC-Materials Testing Services 2013-2014

SYD-00216254-A0

7-May-14



TEST DATA	
Sieve Size (mm)	Percent Passing (%)
112	100.0
80	100.0
56	100.0
40	100.0
28	100.0
20	98.7
14	97.1
10	95.7
5	91.1
2	83.7
0.85	74.2
0.425	63.8
0.25	57.0
0.16	52.7
0.075	46.3

Client: BGC Engineering Inc. Gravel (%) 8.9 C_u n/a
 Sample: TP-5 (SA#2 at 2.3 m depth) Sand (%) 44.8 C_c n/a
 Soil Type: Not Reported to exp Fines (%) 46.3 $W_{content}(\%)$ 16.9
 USCS Soil Name: Silty sand USCS Symbol: SM Test By: TY/DM

Specified Gradational Limits		
Size (mm)	Low Limit % Passing	High Limit % Passing
80		
56		
28		
14		
5		
0.16		
0.08		

Comment: Fines are assumed to be classified as ML (silt). Clients PO Number is 1389-001

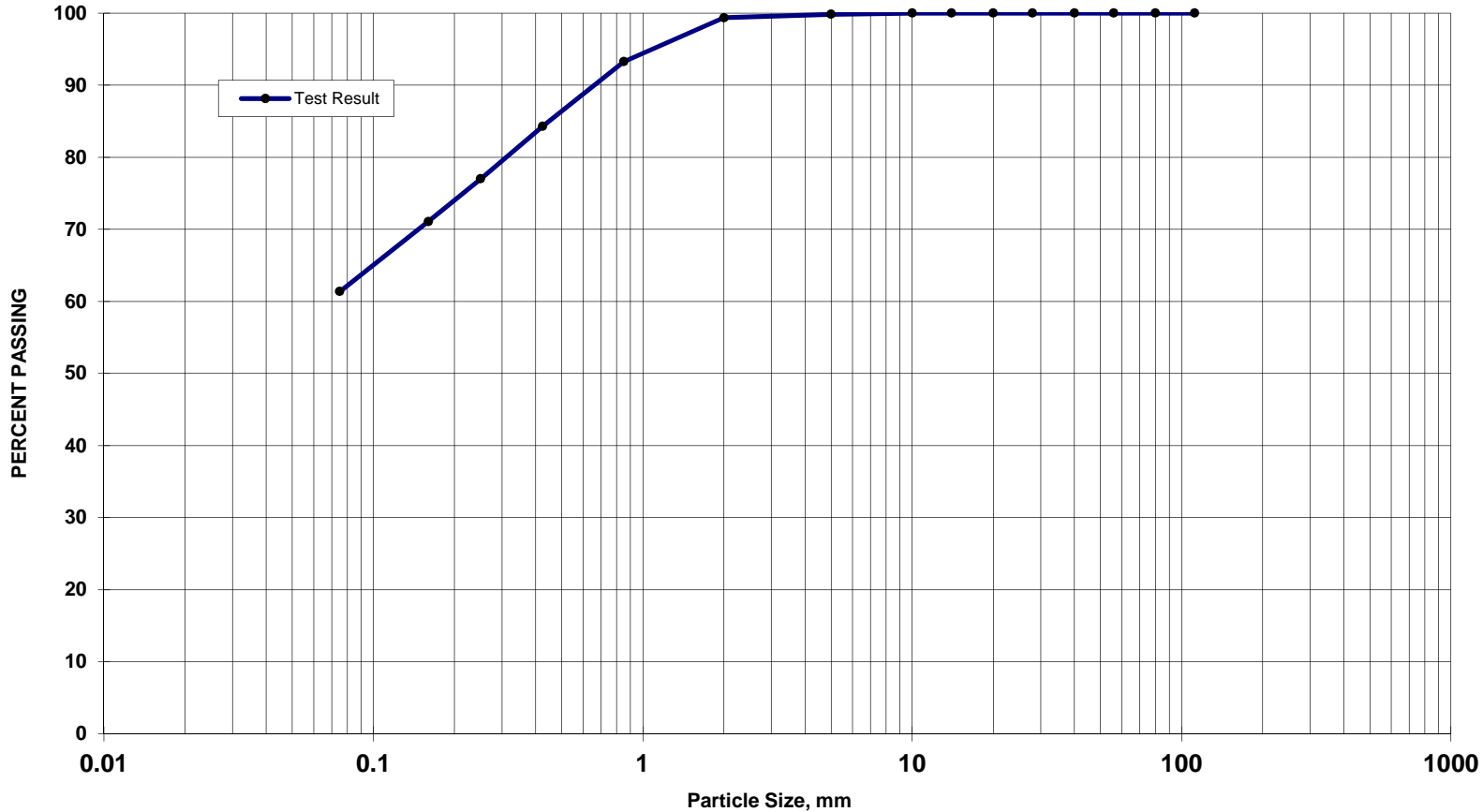


ASTM/USCS Sieve Analysis

BGC-Materials Testing Services 2013-2014

SYD-00216254-A0

7-May-14



TEST DATA	
Sieve Size (mm)	Percent Passing (%)
112	100.0
80	100.0
56	100.0
40	100.0
28	100.0
20	100.0
14	100.0
10	100.0
5	99.8
2	99.3
0.85	93.3
0.425	84.3
0.25	77.0
0.16	71.1
0.075	61.4

Specified Gradational Limits		
Size (mm)	Low Limit % Passing	High Limit % Passing
80		
56		
28		
14		
5		
0.16		
0.08		

Client: BGC Engineering Inc. Gravel (%) 0.2 C_u n/a
 Sample: TP-6 (SA#3 at 2.0 m depth) Sand (%) 38.5 C_c n/a
 Soil Type: Not Reported to exp Fines (%) 61.4 $W_{content}(\%)$ 67.3
 USCS Soil Name: _____ USCS Symbol: _____ Test By: TY/DM
 Comment: Clients PO Number is 1389-001

Your Project #: 1389-001
Site Location: INGONISH
Your C.O.C. #: B096214

Attention: Tony Urquhart

BGC Engineering Inc.
503 Chebucto St
Baddeck, ON
CANADA B0E 1B0

Report Date: 2014/05/15
Report #: R3030189
Version: 1

CERTIFICATE OF ANALYSIS

MAXXAM JOB #: B476182

Received: 2014/05/09, 09:08

Sample Matrix: Soil
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Reference
Metals Solids Acid Extr. ICPMS (1)	1	2014/05/13	2014/05/14	ATL SOP 00058	Based on EPA6020A

Remarks:

Reporting results to two significant figures at the RDL is to permit statistical evaluation and is not intended to be an indication of analytical precision.

* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

(1) This test was performed by Maxxam Bedford

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.

Natalie MacAskill, Sr. Project Manager

Email: NMacAskill@maxxam.ca

Phone# (902)567-1255 Ext:17

=====

This report has been generated and distributed using a secure automated process.

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B476182
Report Date: 2014/05/15

BGC Engineering Inc.
Client Project #: 1389-001
Site Location: INGONISH

ELEMENTS BY ATOMIC SPECTROSCOPY (SOIL)

Maxxam ID		VV5977		
Sampling Date		2014/05/07		
COC Number		B096214		
	Units	TP#6; SOIL	RDL	QC Batch
Metals				
Acid Extractable Manganese (Mn)	mg/kg	18000	2.0	3605058
RDL = Reportable Detection Limit				
QC Batch = Quality Control Batch				

Maxxam Job #: B476182
Report Date: 2014/05/15

BGC Engineering Inc.
Client Project #: 1389-001
Site Location: INGONISH

GENERAL COMMENTS

Results relate only to the items tested.

Maxxam Job #: B476182
 Report Date: 2014/05/15

BGC Engineering Inc.
 Client Project #: 1389-001
 Site Location: INGONISH

QUALITY ASSURANCE REPORT

QA/QC Batch	Init	QC Type	Parameter	Date Analyzed	Value	Recovery	Units	QC Limits
3605058	DLB	Matrix Spike [VV5977-01]	Acid Extractable Manganese (Mn)	2014/05/14		NC	%	75 - 125
3605058	DLB	Spiked Blank	Acid Extractable Manganese (Mn)	2014/05/14		106	%	75 - 125
3605058	DLB	Method Blank	Acid Extractable Manganese (Mn)	2014/05/14	ND , RDL=2.0		mg/kg	
3605058	DLB	RPD [VV5977-01]	Acid Extractable Manganese (Mn)	2014/05/14	4.2		%	35

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

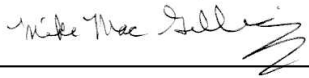
NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was not sufficiently significant to permit a reliable recovery calculation.

Maxxam Job #: B476182
Report Date: 2014/05/15

BGC Engineering Inc.
Client Project #: 1389-001
Site Location: INGNISH

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).

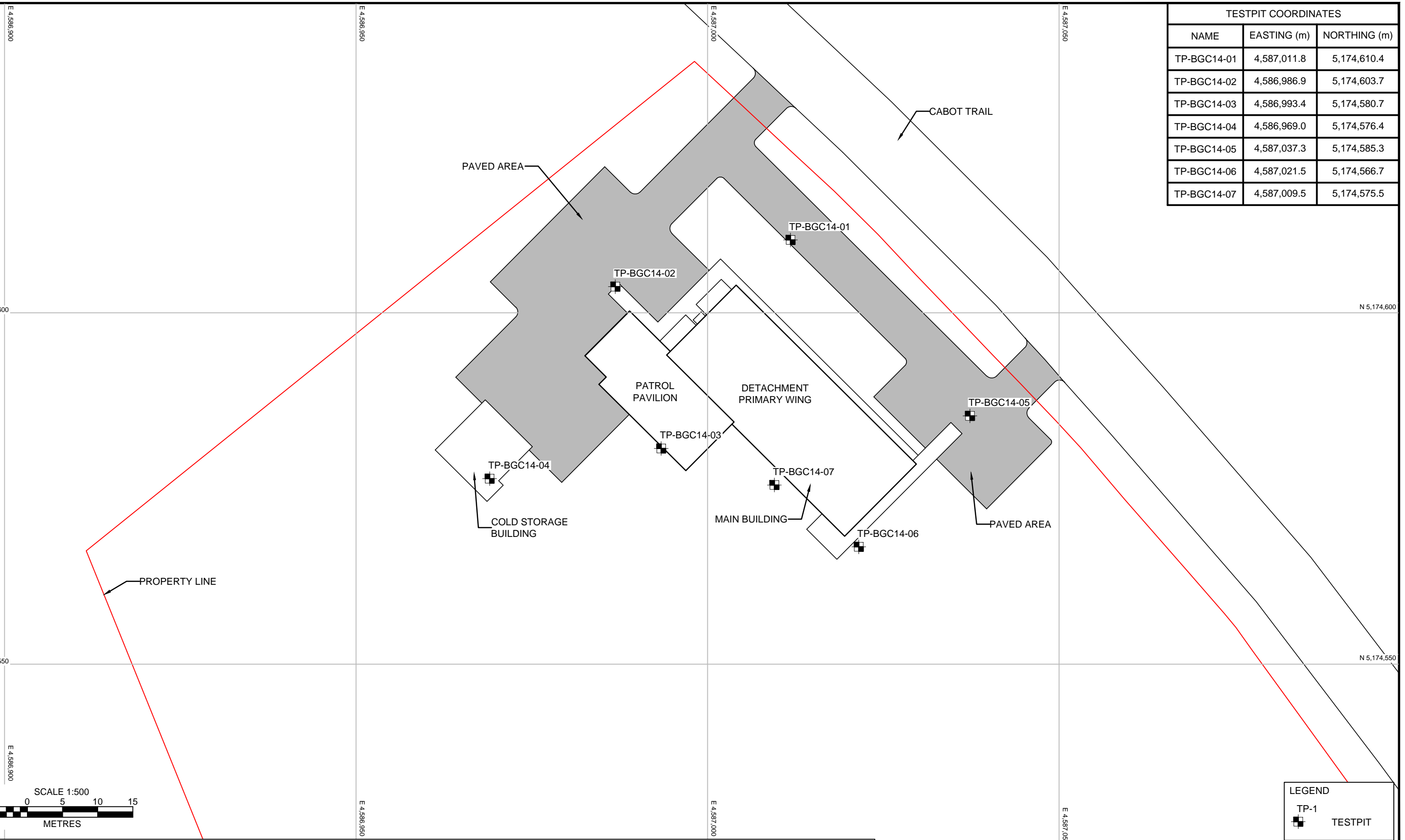
A handwritten signature in black ink, appearing to read "Mike MacGillivray", written over a horizontal line.

Mike MacGillivray, Scientific Specialist (Inorganics)

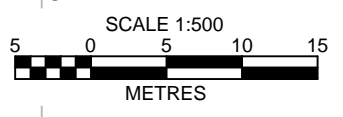
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DRAWINGS

X:\Projects\1389\001\Workspace\2014\0515 REPORT PROPOSED RCMP DETACHMENT - INGNISH, NOVA SCOTIA - GEOTECHNICAL DESIGN - 01 TEST PIT SITE PLAN.dwg Layout: 11x17 Plot Date May 28 14 Time: 2:10 PM



TESTPIT COORDINATES		
NAME	EASTING (m)	NORTHING (m)
TP-BGC14-01	4,587,011.8	5,174,610.4
TP-BGC14-02	4,586,986.9	5,174,603.7
TP-BGC14-03	4,586,993.4	5,174,580.7
TP-BGC14-04	4,586,969.0	5,174,576.4
TP-BGC14-05	4,587,037.3	5,174,585.3
TP-BGC14-06	4,587,021.5	5,174,566.7
TP-BGC14-07	4,587,009.5	5,174,575.5



LEGEND	
TP-1	TESTPIT

NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE NOTED.
2. THIS DRAWING MUST BE READ IN CONJUNCTION WITH BGC'S REPORT TITLED "PROPOSED RCMP DETACHMENT - INGNISH, NOVA SCOTIA - GEOTECHNICAL INVESTIGATION", AND DATED MAY 2014.
3. PROJECTION IS AT577 MTM ZONE 4.
4. TESTPIT COORDINATES SURVEYED BY BGC WITH HANDHELD GPS AND ARE CONSIDERED APPROXIMATE ONLY.
5. UNLESS BGC AGREES OTHERWISE IN WRITING, THIS DRAWING SHALL NOT BE MODIFIED OR USED FOR ANY PURPOSE OTHER THAN THE PURPOSE FOR WHICH BGC GENERATED IT. BGC SHALL HAVE NO LIABILITY FOR ANY DAMAGES OR LOSS ARISING IN ANY WAY FROM ANY USE OR MODIFICATION OF THIS DOCUMENT NOT AUTHORIZED BY BGC. ANY USE OF OR RELIANCE UPON THIS DOCUMENT OR ITS CONTENT BY THIRD PARTIES SHALL BE AT SUCH THIRD PARTIES' SOLE RISK.

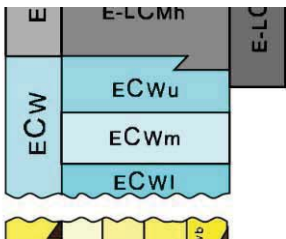
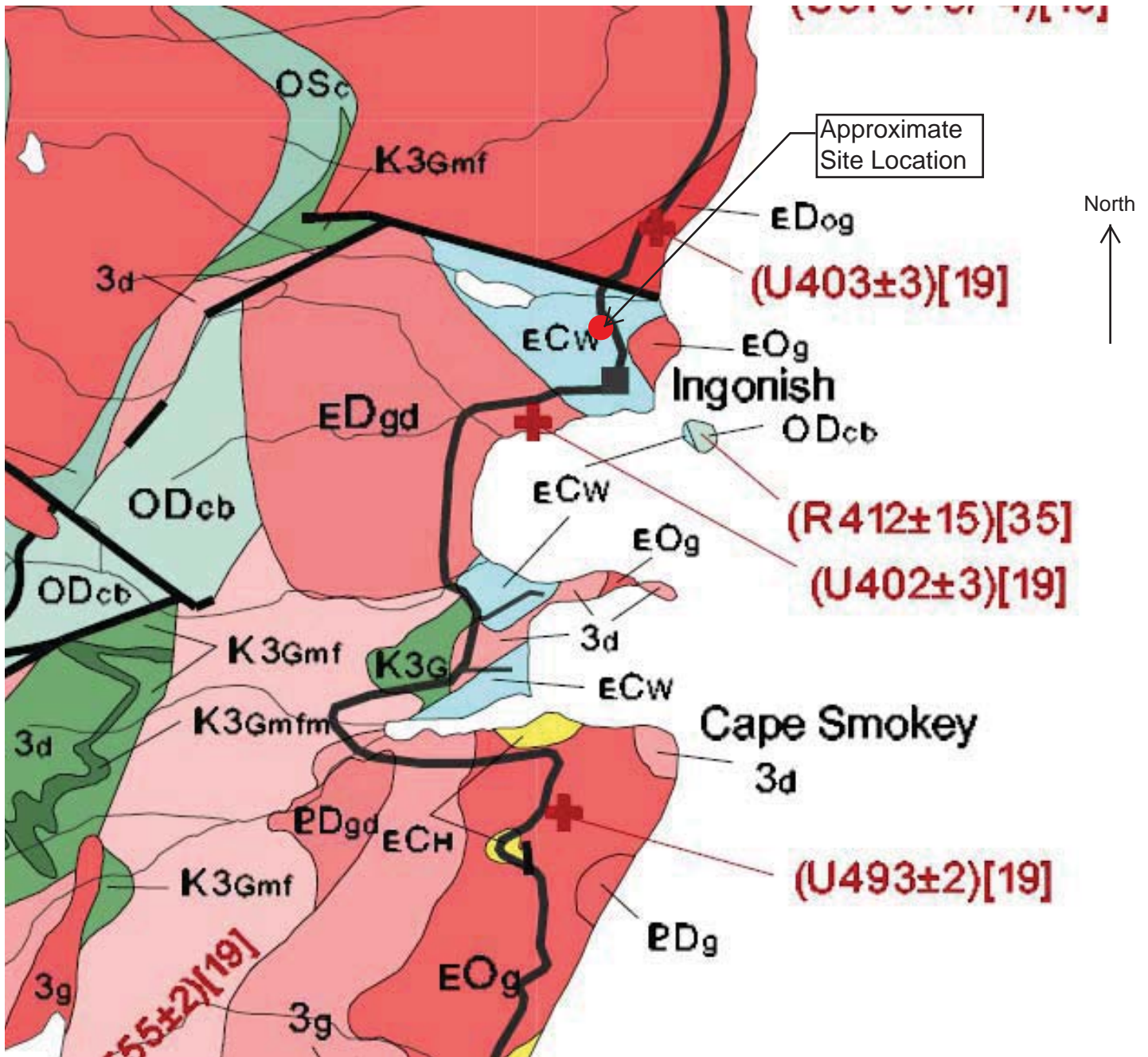
SCALE:	1:500
DATE:	MAY 2014
DRAWN:	LS
CHECKED:	AKU
APPROVED:	EC

BGC ENGINEERING INC.
AN APPLIED EARTH SCIENCES COMPANY

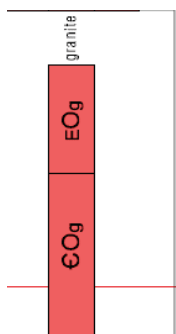
CLIENT:
DSRA ARCHITECTURE

PROJECT: PROPOSED RCMP DETACHMENT - INGNISH, NOVA SCOTIA - GEOTECHNICAL INVESTIGATION	
TITLE: TEST PIT SITE PLAN	
PROJECT No.:	DWG No.:
1389-001	01

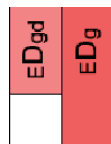
Drawing 2: Bedrock Geology



WINDSOR GROUP (ECW): undivided, 700-1500 m
UPPER WINDSOR GROUP (ECW_u): LIME-KILN BROOK, CHURCHVILLE and HOOD ISLAND FORMATIONS: mudstone, sandstone, minor gypsum and shallow marine limestone, 300-800 m (Viséan (Holkerian-Asbian), C-E subzones fauna and spores)
MIDDLE WINDSOR GROUP (ECW_m): PUGWASH MINE, FORBES LAKE, ADDINGTON, WALLACE BROOK and LAKEVALE FORMATIONS: halite, anhydrite, gypsum and mudstone, 300-500 m (Viséan (Holkerian), B subzone fauna and spores)
LOWER WINDSOR GROUP (ECW_l): BRIDGEVILLE, HOLMES BROOK, HARTSHORN, GAYS RIVER and MACUMBER FORMATIONS: anhydrite, salt, marine dolostone and limestone (Viséan (Arundian), A subzone fauna and spores)
LOWER and MIDDLE WINDSOR GROUPS (ECW_{l/m}): undivided



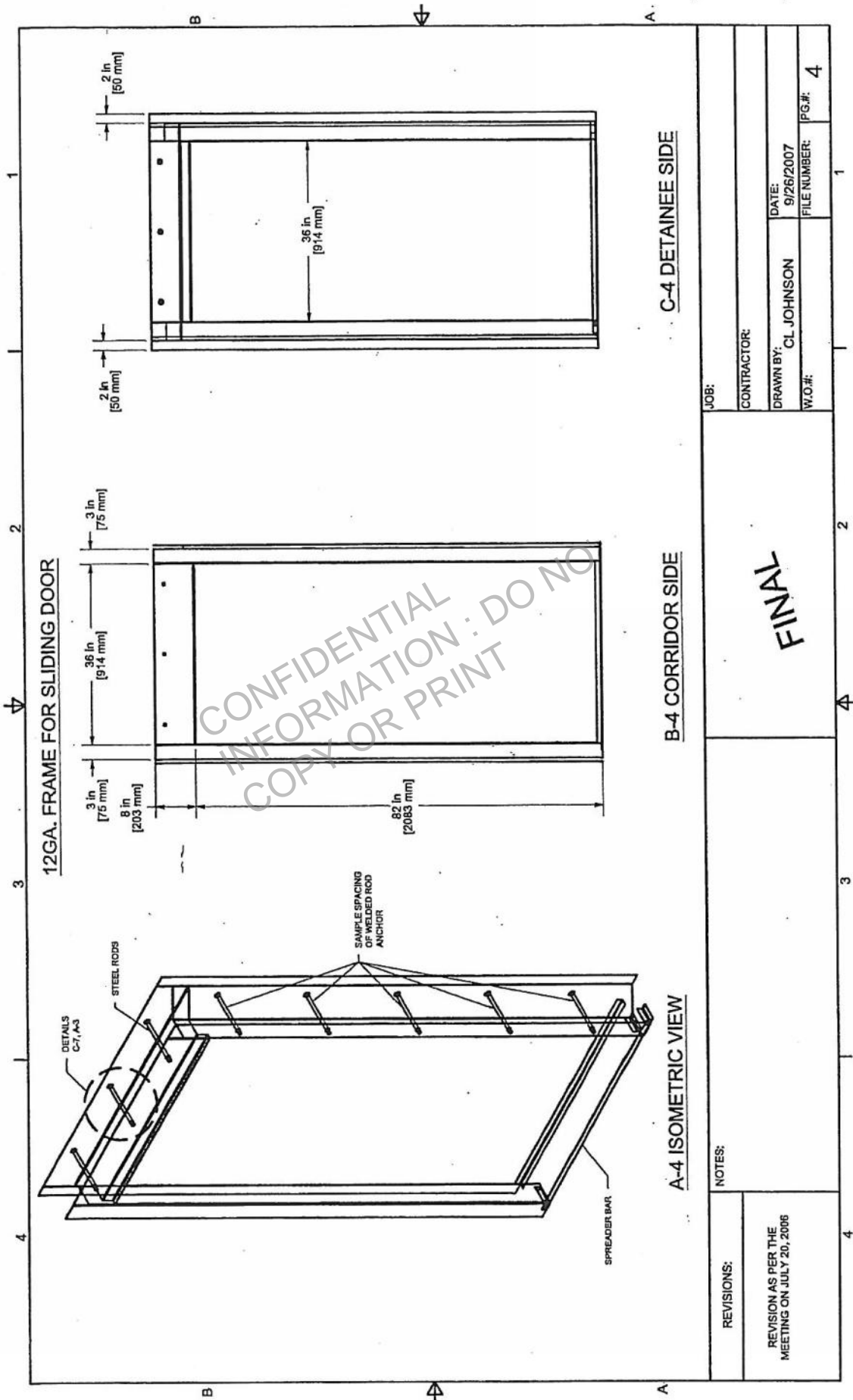
(EO_g): granite (U-Pb concordant zircon age of 493±2 Ma¹⁹)



(ED_{gd}): granodiorite (U-Pb concordant zircon age of 402±3 Ma¹⁹ for Cameron Brook Pluton)

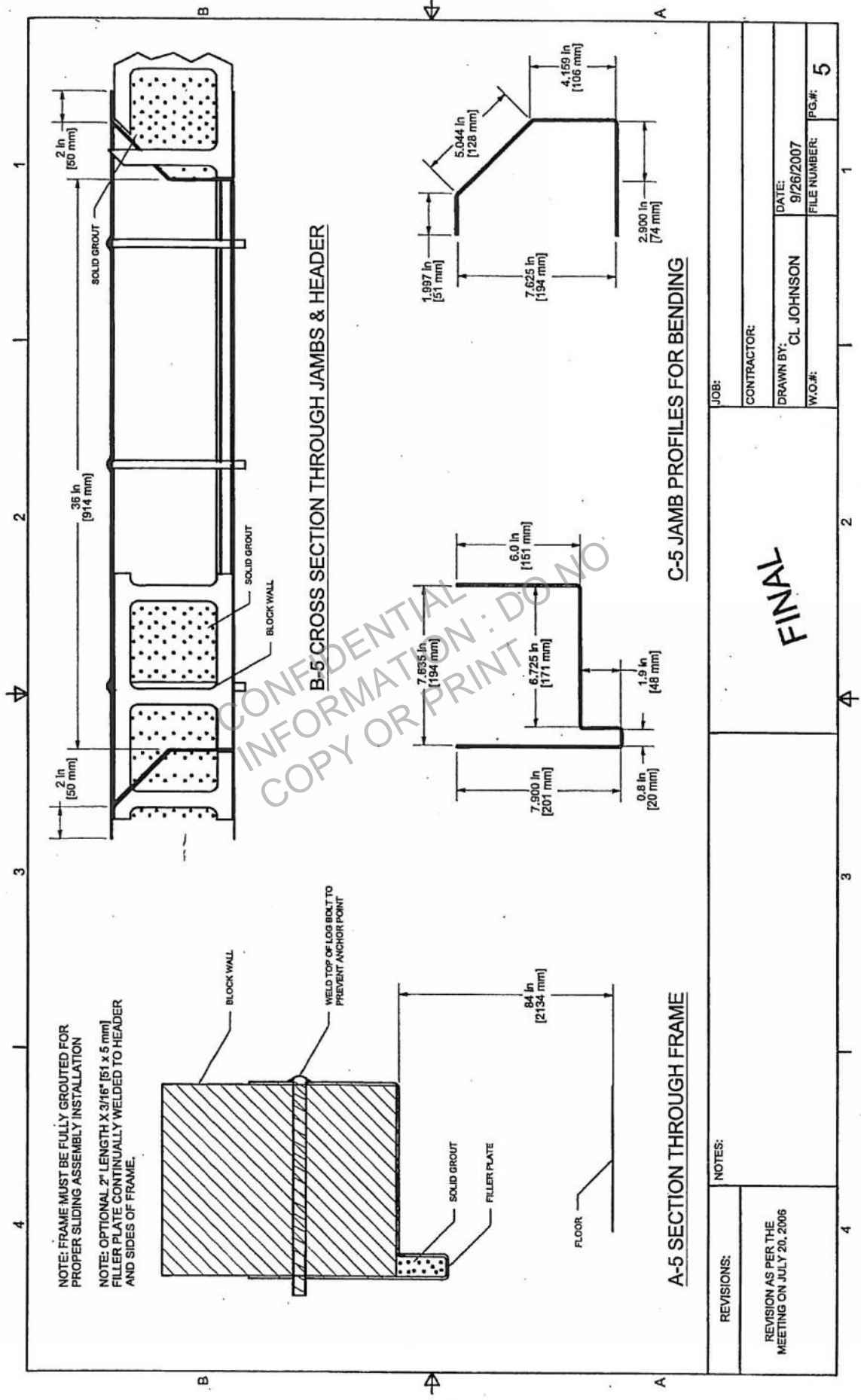
(ED_g): granite (Rb-Sr whole rock isochron age of 400±5 Ma⁴⁴ for West Branch North River Pluton)

APPENDIX IV - DETENTION CELL DRAWING



REVISIONS:	NOTES:		
	REVISION AS PER THE MEETING ON JULY 20, 2008		
JOB:		CONTRACTOR:	
DRAWN BY:		CL JOHNSON	DATE: 9/26/2007
W.O.#:		FILE NUMBER:	PG.#: 4

FINAL



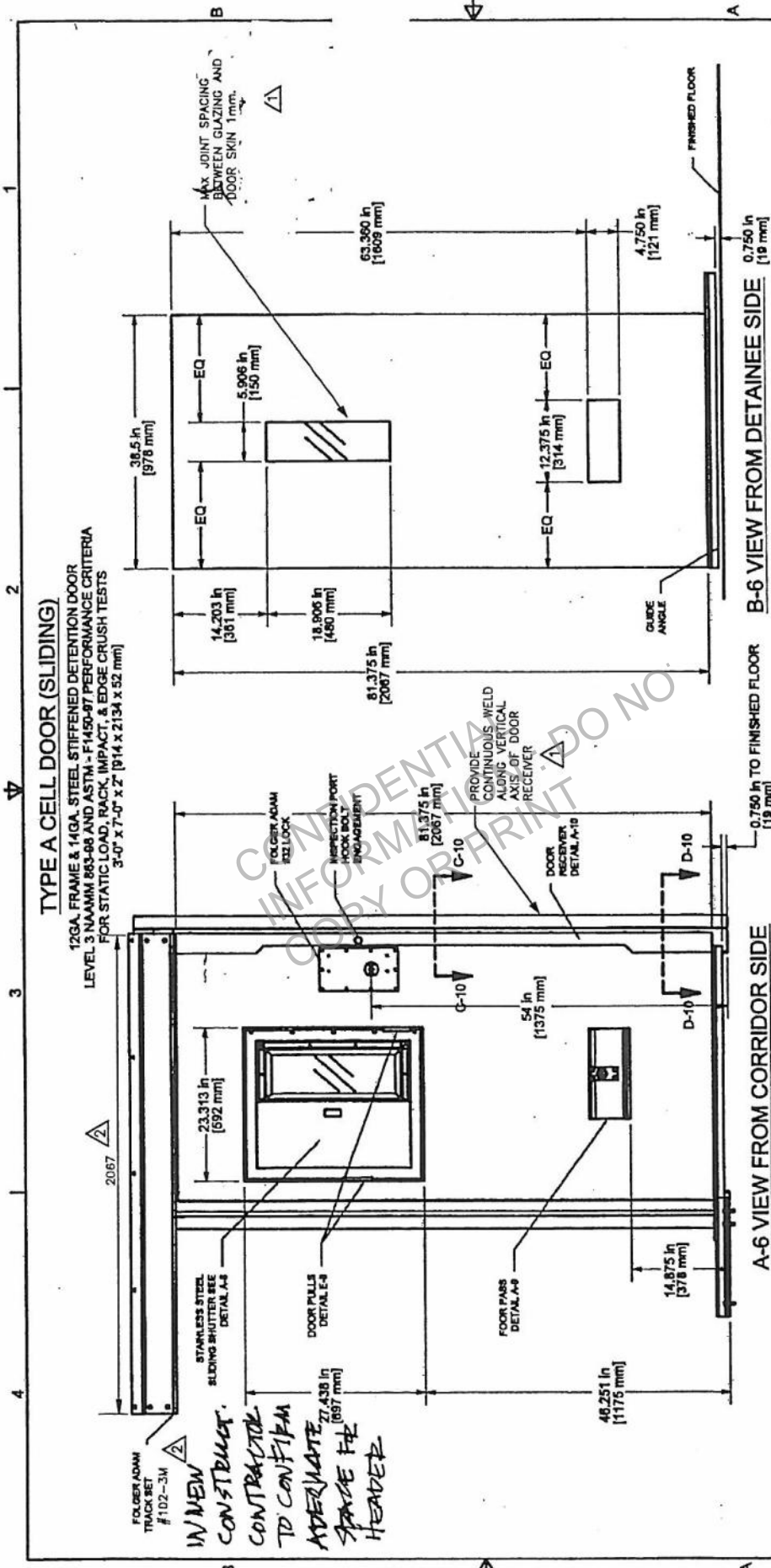
NOTE: FRAME MUST BE FULLY GROUTED FOR PROPER SLIDING ASSEMBLY INSTALLATION

NOTE: OPTIONAL .2" LENGTH X 3/16" [51 x 5 mm] FILLER PLATE CONTINUALLY WELDED TO HEADER AND SIDES OF FRAME.

CONFIDENTIAL INFORMATION: DO NOT COPY OR PRINT

REVISIONS:	NOTES:		
	REVISION AS PER THE MEETING ON JULY 20, 2006		
JOB:		CONTRACTOR:	DATE:
DRAWN BY: CL JOHNSON		W.O.#:	FILE NUMBER:
PG.#: 5			

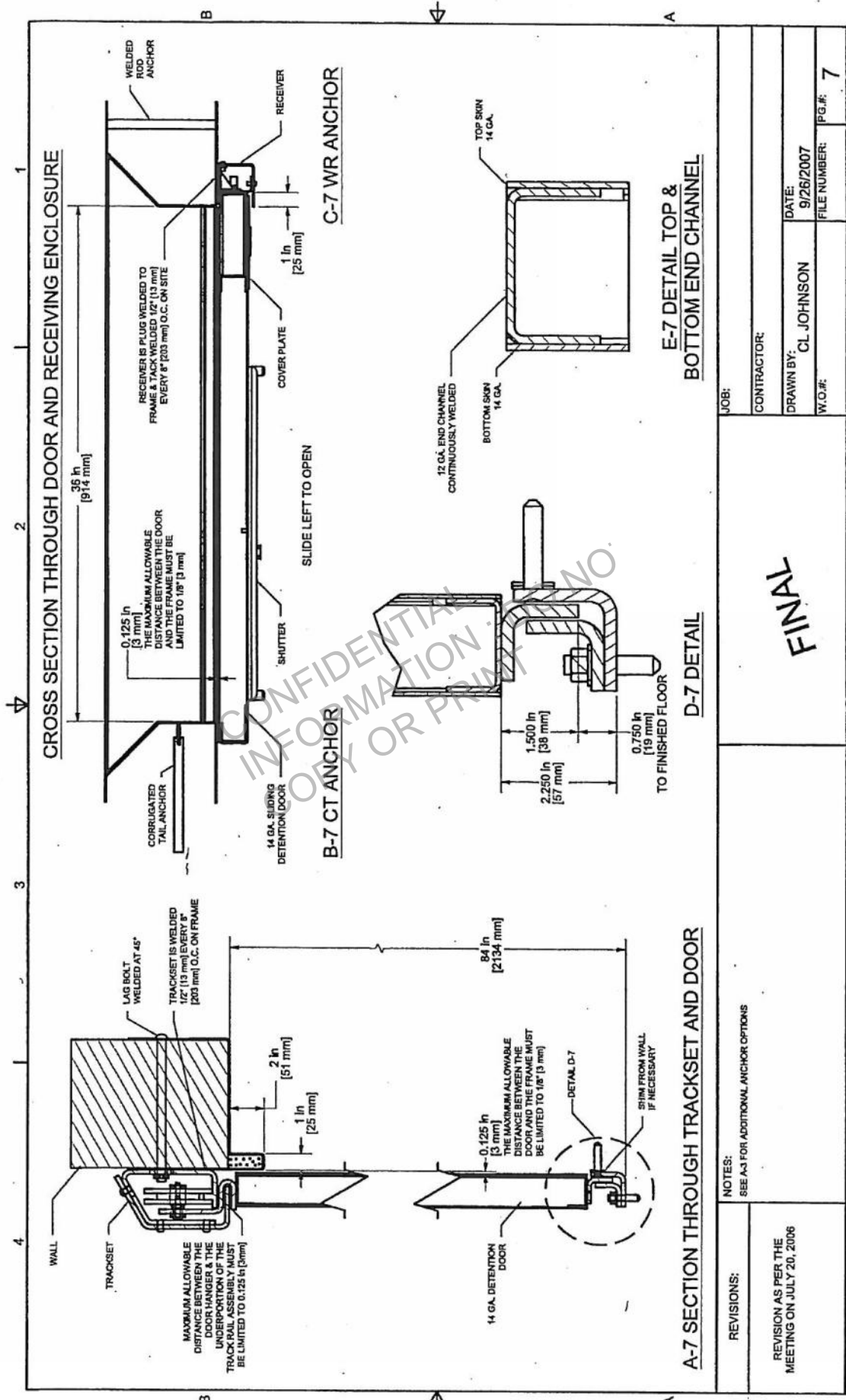
FINAL



IN NEW CONSTRUCTION CONTRACTOR TO CONFIRM ADEQUATE SPACING FOR HEADER

REVISIONS:	NOTES:	1 MARCH 31, 2011 2 SEPT. 30, 2011 THIS DRAWING IS THE EXCLUSIVE PROPERTY OF THE NCP. NO REPRODUCTION OR TRANSMISSION IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, IS PERMITTED WITHOUT THE WRITTEN PERMISSION OF THE NCP. THIS DRAWING MUST BE RETURNED ON DEMAND.
	JOB: CONTRACTOR: DRAWN BY: CL JOHNSON DATE: 9/26/2007 W.O.#: FILE NUMBER: P.O.#: 6	

FINAL



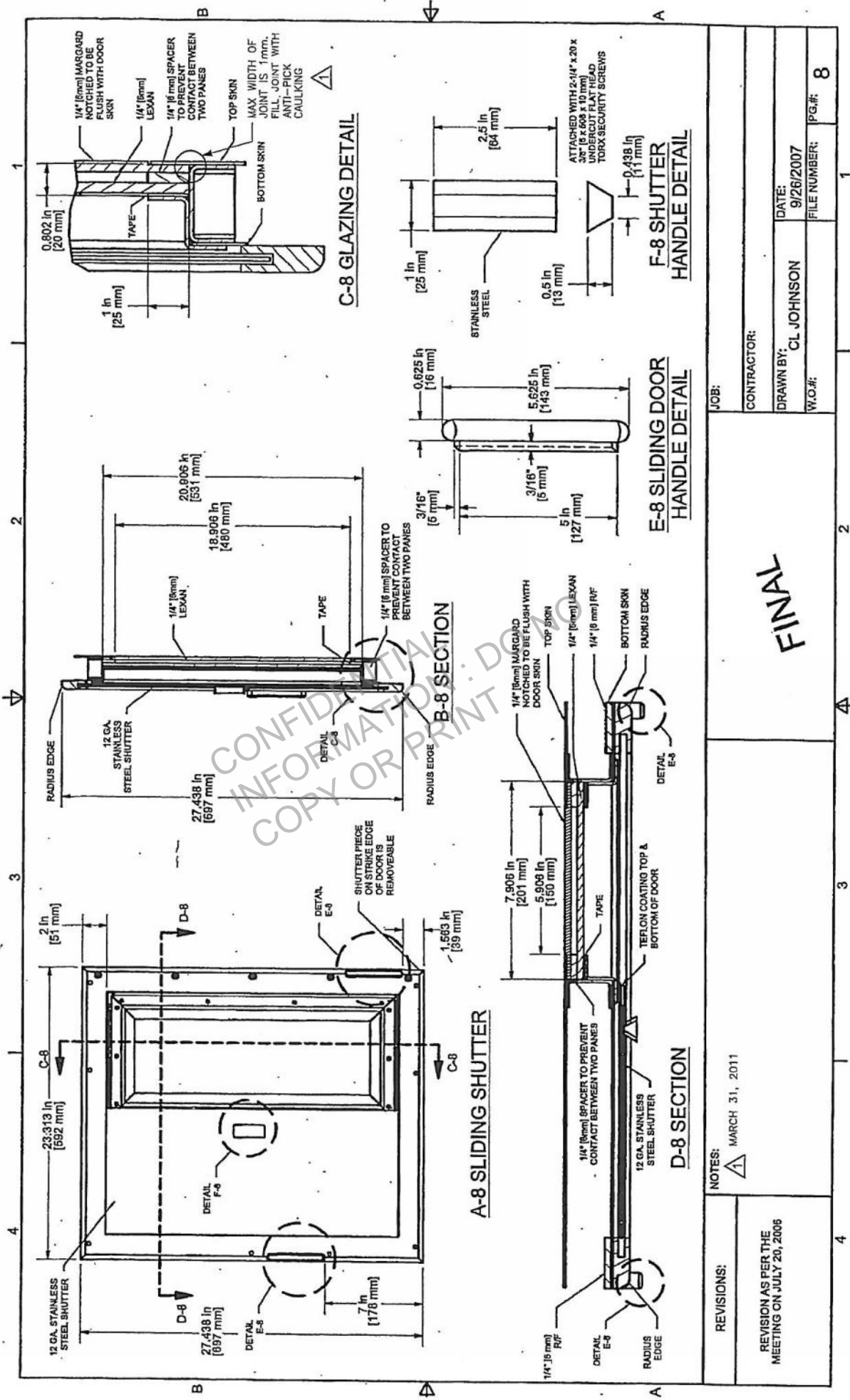
CROSS SECTION THROUGH DOOR AND RECEIVING ENCLOSURE

E-7 DETAIL TOP & BOTTOM END CHANNEL

D-7 DETAIL

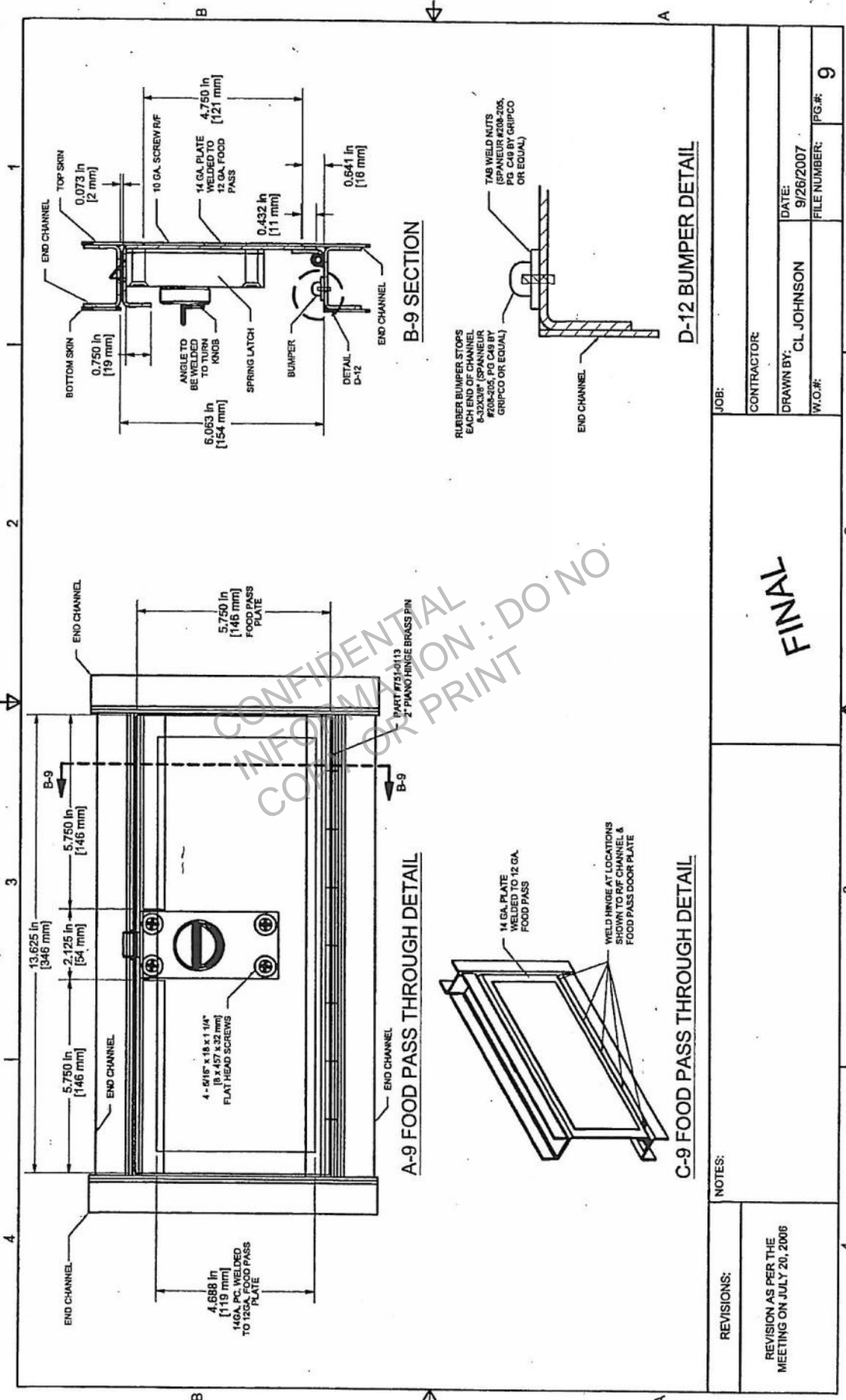
A-7 SECTION THROUGH TRACKSET AND DOOR

<p>REVISIONS:</p> <p>REVISION AS PER THE MEETING ON JULY 20, 2006</p>	<p>NOTES:</p> <p>SEE A-3 FOR ADDITIONAL ANCHOR OPTIONS</p>		<p>FINAL</p>	<p>JOB:</p>
	<p>CONTRACTOR:</p>			<p>DATE:</p> <p>9/26/2007</p>
	<p>W.O.#:</p>			<p>FILE NUMBER:</p> <p>7</p>
	<p>DRAWN BY:</p> <p>CL JOHNSON</p>			<p>PG.#:</p> <p>7</p>



FINAL

REVISIONS:	JOB:		
	CONTRACTOR:		
	DRAWN BY: CL JOHNSON		
	DATE: 9/26/2007		
REVISION AS PER THE MEETING ON JULY 20, 2006			FILE NUMBER:
			PG.#: 8



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REVISIONS:		NOTES:	
REVISION AS PER THE MEETING ON JULY 20, 2006			
JOB:		CONTRACTOR:	
DRAWN BY: CL JOHNSON		DATE: 9/26/2007	
W.O.#:		FILE NUMBER: PG.# 9	

D-12 BUMPER DETAIL

B-9 SECTION

A-9 FOOD PASS THROUGH DETAIL

C-9 FOOD PASS THROUGH DETAIL

REVISIONS:

REVISION AS PER THE MEETING ON JULY 20, 2006

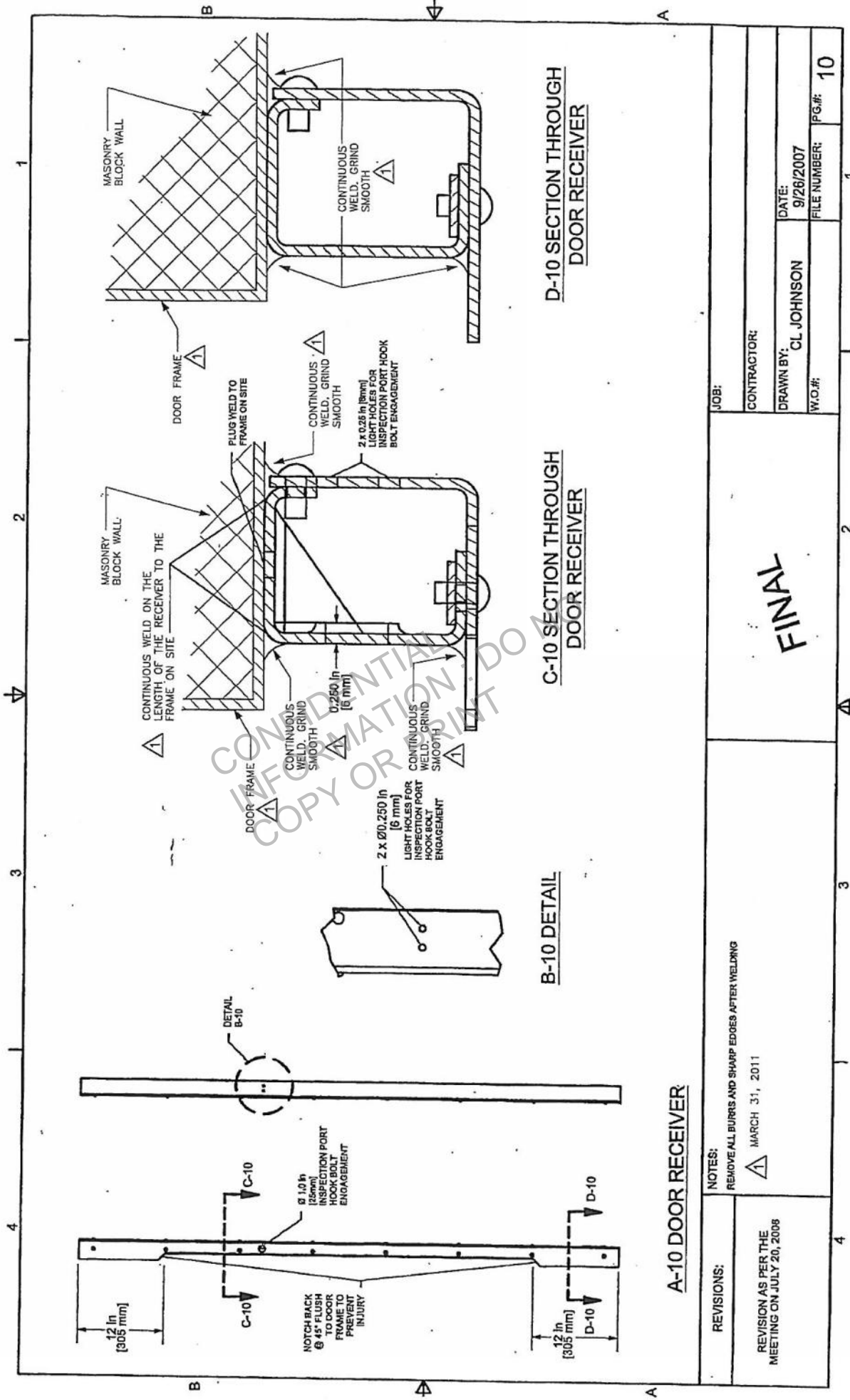
JOB:

CONTRACTOR:

DRAWN BY: CL JOHNSON

DATE: 9/26/2007

FILE NUMBER: PG.# 9



A-10 DOOR RECEIVER

NOTES:
REMOVE ALL BURRS AND SHARP EDGES AFTER WELDING
MARCH 31, 2011

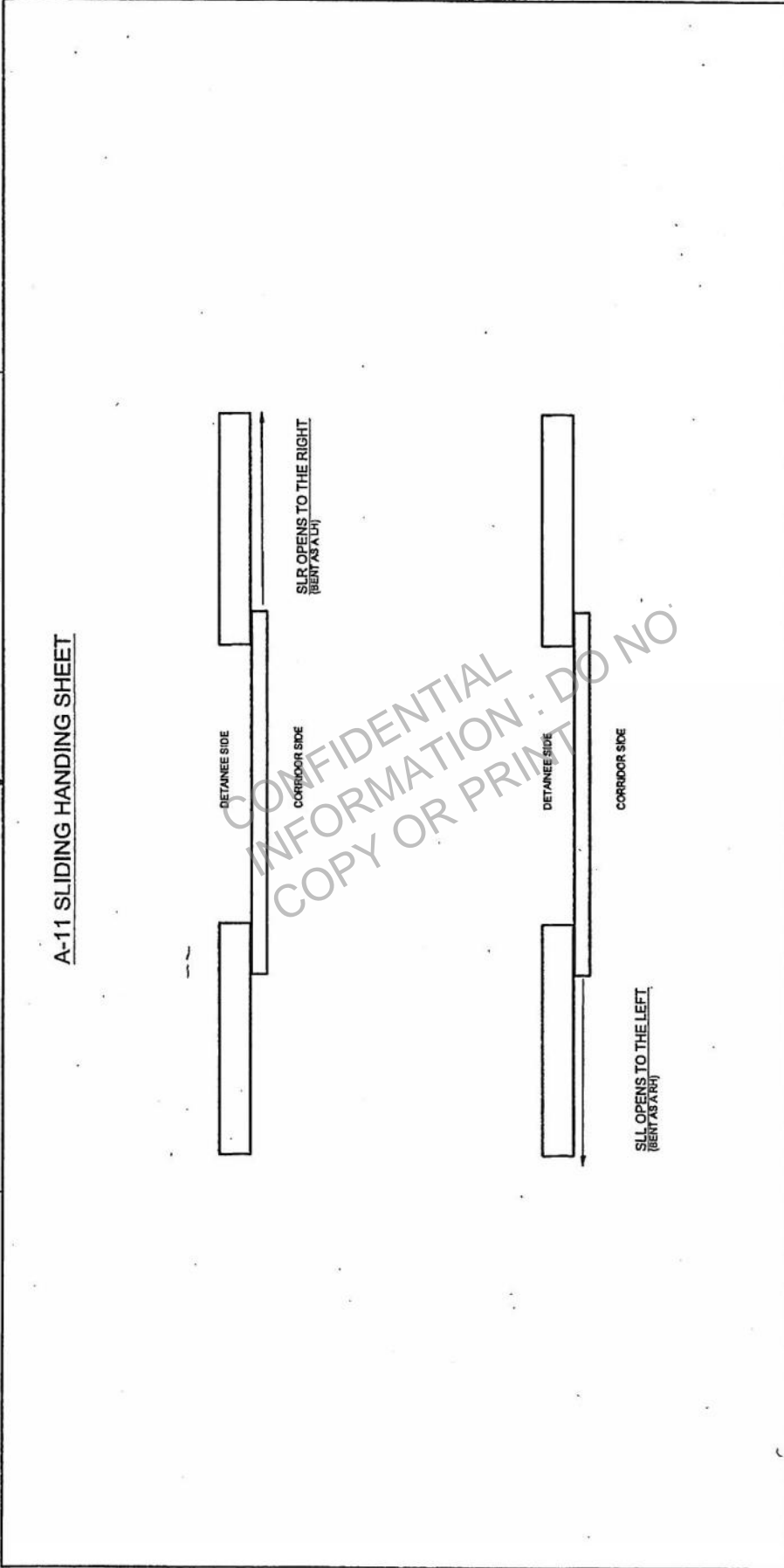
REVISIONS:
REVISION AS PER THE MEETING ON JULY 20, 2008

FINAL

JOB:	
CONTRACTOR:	
DRAWN BY: CL JOHNSON	DATE: 9/26/2007
W.O.#:	FILE NUMBER: P.G.#: 10

1 2 3 4

4 3 2 1



<p>REVISIONS:</p> <p>REVISION AS PER THE MEETING ON JULY 20, 2006</p>	<p>NOTES:</p> <p style="text-align: center; font-size: 2em; font-weight: bold;">FINAL</p>
<p>JOB:</p>	
<p>CONTRACTOR:</p>	
<p>DRAWN BY: CL JOHNSON</p>	
<p>DATE: 9/26/2007</p>	
<p>W.O.#:</p>	
<p>FILE NUMBER: PG.#: 11</p>	